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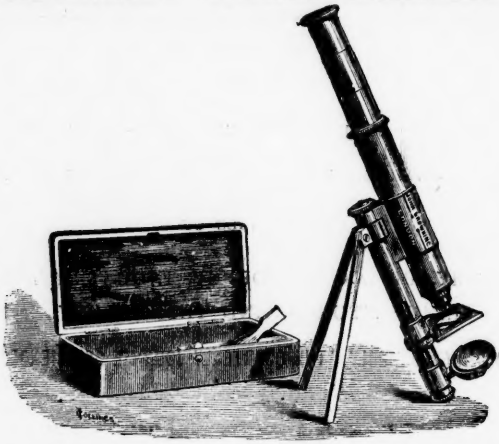

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THE

JOURNAL OF SCIENCE.

DECEMBER, 1880.

I. SPECTRUM ANALYSIS.

By Dr. AKIN.

IT has been truly said of Dr. Young's "Course of Lectures on Natural Philosophy," delivered at the Royal Institution (it is to be feared before a somewhat unappreciating audience) in the first years of this century, that it contains the germs of many more discoveries than can be found foreshadowed in any other single extant book. In p. 438 of the first volume of that invaluable work (ed. of 1807) the author observes:—"In light produced by the combustion of terrestrial substances the spectrum is still more interrupted; thus the bluish light of the lower part of the flame of a candle is separated by refraction into five parcels of various colours; the light of burning spirits, which appears perfectly blue, is chiefly composed of green and violet rays, and the light of a candle into which salt is thrown abounds in a pure yellow, inclining to green, but not separable by refraction. The electrical spark furnishes also a light which is differently divided in different circumstances." Of this passage it may be asserted that it contains the germ, although it has not actually formed the starting-point, of researches which, prosecuted at first in a desultory manner, have since, after the lapse of half a century, given rise to a series of discoveries which must be classed among the most striking, if not altogether among the most novel, of our age. The above statement by Dr. Young was neither absolutely the first nor the only forerunner of those discoveries. It is said that already, "in 1752, Melville observed the effect of soda on flame;" and

Dr. Wollaston, in 1802, had first indicated those "five parcels" of rays in candle-light mentioned by Dr. Young, as well as the existence of a diversity in the spectra of electric sparks in different circumstances. The celebrated Fraunhofer, in 1815, speaking rather vaguely of "the light of electricity," observed that it gave a different spectrum from those of "the sun and of fire;" whilst Sir H. Davy—viewing the subject in a much more philosophical manner—made, in 1822, the novel and important assertion that "the light generated in electrical discharges depends *principally* on some properties or substances belonging to the ponderable matter through which it passes." In the same year Sir D. Brewster and Sir J. Herchel had devoted some attention to the investigation of the spectra of coloured flames; and in a paper by Mr. Fox Talbot,—of Talbotype celebrity,—of the year 1826, the author states that "the muriate, sulphate, or carbonate of soda" all gave the same yellow ray in the spectrum, while "the nitrate, chlorate, sulphate, and carbonate of potash agreed in giving a bluish white tinge to the flame. Hence," he continues "the yellow rays may indicate the presence of soda, but they, nevertheless, frequently appear where no soda can be supposed to be present." In fact, "ignited sulphur produced the very same" rays. In 1827 Sir J. Herschel reverted to this subject in his celebrated treatise on Light, where, after describing the colourations which different "saline bodies," "in general," impart to flames, he observes that "the colours thus communicated by the different bases to flame afford in many cases a ready and neat way of detecting extremely minute quantities of them;" and he assigns also reasons to show that "these tints arise from the molecules of the colouring-matter reduced to vapour, and held in a state of violent ignition.

Thus the matter rested for a while. In the year 1834 the same indefatigable Mr. Talbot made the remarkable discovery that the two bases, lithia and strontia, while both impart a red tinge to flame, may yet be distinguished by the different lines visible in their prismatically analysed light; in consequence of which, and of some later observations, he in 1836 insisted "that an extensive course of experiments should be made on the spectra of chemical flames," as "the definite rays emitted by certain substances—as, for example, the yellow rays of the salts of soda—possess a fixed and invariable character, which is analogous in some measure to the fixed proportion in which all bodies combine, according to the atomic theory." In the same paper Mr. Talbot describes also the spectra of gold, silver, zinc, and copper

leaves "deflagrated by galvanism." But a much more important—and perhaps, as regards real novelty, the most important—series of researches on the subject of the spectra of metals acting as dischargers of the electric current was published, in the year preceding, by Professor Wheatstone. From these researches Mr. Wheatstone inferred "that electric light results from the volatilisation and ignition (not combustion) of the ponderable matter of the conductor itself;" and that, as the spectra were altogether different according to the nature of the latter, "by this mode of investigation [that is, by the analysis of either the electro-magnetic or voltaic spark] the metals may be readily distinguished from each other." Mr. Wheatstone found also that, with the ordinary electric spark, the lines of the spectra were "different in number and position in every metal employed," without stating, however, whether they coincided with those produced by the corresponding substances employed as galvanic or electro-magnetic electrodes. This it would seem important to have remarked on, as the author had observed that "the light which accompanies the ordinary combustion of the metals" really gave "appearances totally dissimilar to the above." After these investigations nothing of any great importance was brought to light concerning the spectra of sparks. M. Foucault, in 1849, made some observations which yielded no remarkable results, except one to which we shall have to revert, and which was extremely striking, but is not connected with our present subject. M. Masson, in 1851 and 1855, published researches which, however painstaking and elaborate, tended rather to confuse than to elucidate the matter in hand. Much more valuable and highly suggestive was a paper by M. Angström, published in 1855, who for the first time noticed the very interesting fact that, whilst part of the lines of the spectra of sparks belonged to the metals which formed the electrodes, others were of aërial origin, and could consequently be varied according to the nature of the gaseous medium in which the discharge was taken. This fact was noticed at about the same time in America by Mr. Alter, and was further investigated in 1858 by M. Van der Willigen; whilst the subject of the spectra of the light of exhausted tubes filled with gases of extremely small density, and traversed by induction-currents,—in other words, of gases made glowing by electricity,—was elaborately examined in 1858-9 by M. Plücker.

From these various researches, and especially from those of Mr. Wheatstone on the metals and of M. Plücker on

gases, the constancy and distinctness of the spectra of the chemical elements, when made incandescent by electricity, had pretty clearly resulted, and the expediency of their adoption as a chemical test had thus become manifest. A powerful impetus in this direction—or, rather, to the use of the optical phenomena of substances when rendered incandescent or self-luminous by whatsoever means, in order to their chemical discrimination—was provided by some researches on flames by Mr. Swan, first published in 1856. By this observer "absolute identity was shown to exist between the spectra of dissimilar carbo-hydrogen compounds," thus proving (not, however, in a manner altogether irrefragable) the dependence of the constitution of the spectra solely on the chemical composition of the compounds; and, adverting in particular to the colouration of flames by soda, he stated that it formed such a delicate test for sodium that 1-2,500,000th grain could be detected by it. Under the circumstances which we have attempted to describe—and among which we should include also the publication of some valuable researches on coloured flames by Prof. Miller, of King's College, in 1845—Profs. Kirchhoff and Bunsen were scarcely justified in proposing, in 1860, the optical characters of glowing gases as the basis of "an entirely new method of qualitative chemical analysis." Nor, on the other hand, did they place the trustworthiness of the proposed method, whether new or not, beyond a doubt. MM. Kirchhoff and Bunsen, in point of fact, had investigated the spectra of a number of binary and other compounds of the six metallic elements—sodium, lithium, potassium, strontium, calcium, and barium, as volatilised in flames; and they found that these spectra were distinct from one another, and always the same, whatever the temperature of the flame, at least between the limits of from 2000° to 8000° C. They asserted, further, that the spectrum of any one of those metals was independent of the nature of the other elements with which it formed a binary compound or salt, except that "those compounds of a metal gave the brightest spectra which were most volatile;" and that, in fact, the spectrum of any such compound was the same as that of the uncombined metal itself, volatilised by the electric spark. All this, however, was yet very far from demonstrating, as alleged, that these spectra might be relied on "as absolute proofs of the presence of the particular metal" in each special case. In the first place, it was strange, as asserted, that the spectrum of any of the metals combined with oxygen or chlorine, for instance, should be altogether

uninfluenced by the nature of the latter substance, unless it were supposed that the compound was decomposed in the flame, the reverse of which opinion Prof. Kirchhoff at least seemed openly to favour. Yet that such is really the case seems to be now established beyond doubt. But then it is evident also that, in the case of a compound undecomposable by heat, the spectra furnished by MM. Kirchhoff and Bunsen, and which really relate but to the uncombined metals, would be no guide whatever to the detection of the metallic element which it contains. In the next place, an even more important remark than the above (which, indeed, has to be practically considered principally in reference to the matter which later on will be treated of, but is of less import in ordinary chemical analysis) is suggested by the circumstance that it had nowise been proved that, of the fifty-six other elements then known, the spectrum of none coincided, either totally or in part, with any one of the six spectra which alone had been mapped and examined; and, in fact, M. Kirchhoff—who had already found that the influence of temperature is far from being so totally immaterial as at first had been supposed—actually met at a later period with examples in which lines in the spectra of two different substances coincided. What some would call a practical answer to these objections, which would certainly have been urged from numerous quarters had the subject been mooted by some fortunate, or rather unfortunate, novice,—an answer which, however, is not the least to the point,—was furnished by the discovery, on the part of Prof. Bunsen, of two new metals whose existence had been first revealed to him by additional lines in the spectra of known metals, together with which the former occurred as otherwise unsuspected impurities. A few more such discoveries have since been made which, indeed, prove beyond cavil the value of the method in question, practically at least, although not in theory; for, besides the difficulties which we have already pointed out, some other observations have since been brought forward which, whilst they may possibly open a wide and fruitful field to inquiry for the future, for the present throw doubt on the reliableness of the optical test as an absolute sign of chemical nature. Not to mention certain observations by Dr. Robinson, of Armagh, which bear in the same direction, it has been alleged by M. Plücker that an elementary gas, such as nitrogen, may possess three spectra of altogether varying character, depending upon "three allotropic states; and, on the other hand, an English chemist who may be taken to express the opinions of MM. Bunsen

and Kirchhoff, allows that "certain metals—calcium, barium, and strontium—yield spectra of two kinds; one of these, seen at the lower temperature, and consisting of broad bands, being resolved at a higher temperature into bright lines. These bright lines . . . characterise the true metallic spectrum, while the band spectrum is probably produced by the incandescent vapour of a metallic compound." The same chemist observes further that "it has been stated that all the various forms of carbon-compounds, when in the state of incandescent gas, yield identical spectra. This proves not to be the case."

Notwithstanding the difficulties adduced—which, on being more accurately examined, seem calculated rather to lead to new and important discoveries than to discredit those already made, or to permanenly invalidate the method to which they are owing,—the method of spectrum analysis prepared and pointed out as important by many a previous investigator, and brought into prominent notice by MM. Kirchhoff and Bunsen, is certainly a most valuable accession to the chemical philosopher. In fairness it should also be stated that, although the researches of the two distinguished professors had been, in almost every respect, anticipated by others, yet such was the indecision prevalent on the subject before their own publications that a physicist of such great eminence as Sir D. Brewster—to whom optical science owes almost innumerable discoveries, and who, in 1842, had himself for the second time made observations on this very matter of the colouration and spectra of flames—gave out in 1860, when MM. Kirchhoff and Bunsen's memoirs were yet unknown in England, that, besides in that of soda, the "ray [D] is prominent also, according to W. A. Miller, in the flames of lime, strontia, baryta, zinc, iron, and platinum, and, according to Angström, in the electric flame of every metal examined by him." Yet the great stir which, upon the introduction of the new method, ensued in the scientific world, was perhaps in no small measure owing to its accidental connection with another series of researches, some account of which we now proceed to give.

Wollaston, in 1802, noticed for the first time that the solar spectrum was interrupted by seven black lines, five of which he took to indicate the limits of the four (assumed) primary colours. Fraunhofer, in 1815, with superior apparatus, of his own make and invention, numbered about 600 such lines, some 350 of which he laid down in his celebrated map of the solar spectrum. The light of the moon, of Venus, and of Mars, according to Fraunhofer's observations

in 1815 and 1823, gave lines in strict coincidence with those of sunlight, whilst the lines in the spectra of such of the fixed stars as he examined proved to differ in part both from those of sunlight and among one another. The "light of lamps" showed no dark lines, but, on the contrary, one bright yellow line which corresponded in refrangibility to the black line marked by Frauenhofer as *D* in the solar spectrum.

Sir D. Brewster, in 1832, observed that, in transmitting light through nitrous acid gas, a great number of new black lines became apparent in the spectrum—a discovery "lying so close at the root of atomical science," its author a few years later emphatically remarked, "that I am persuaded it will open up a field of research which will exhaust the labours of philosophers for centuries to come." In 1833 Prof. Miller, of Cambridge, conjointly with Prof. Daniell, noticed a similar behaviour of bromine and iodine vapour towards light; whilst Sir D. Brewster, "the first and principal object" of whose inquiries was "the discovery of a general principle of chemical analysis, in which simple and compound bodies might be characterised by their action on definite parts of the spectrum," in 1836 added the important discovery that the number of dark lines in the solar spectrum depended on the thickness of the layer of atmosphere which it must traverse to reach the observer, and that, consequently, some of those lines were owing to a similar absorptive action on the part of the colourless gases of the atmosphere as he had previously discovered in red-coloured nitrous acid gas. In 1842, moreover, Sir D. Brewster was "surprised to find" that, "in the spectrum of deflagrating nitre, the red ray, discovered by Mr. Fox Talbot, . . . occupied the exact place of the line *A* in Fraunhofer's spectrum," and he was "equally surprised to see a luminous line corresponding with the line B of Fraunhofer." The phenomena of absorption of light, and the consequent production of dark lines in luminous spectra, were elaborately investigated by Prof. Miller, of King's College, in 1845; and various hypotheses were hazarded, notably one by Baron Wrede in 1834, on the mechanical origin of those lines. In 1849 M. Foucault made an observation which was calculated to throw considerable light on the subject, but the bearings of which he himself, as well as his contemporaries, excepting one, utterly failed to perceive. "I caused an image of the sun," relates M. Foucault, "to fall on the [voltaic] arc, and I convinced myself in this way that the double bright line of the arc coincides exactly with the double dark line [D] of the solar spectrum. This process of investigation furnished

me matter for some unexpected observations. . . . It showed to me that this arc . . . absorbs the rays D, so that the above-mentioned line D of the solar spectrum is considerably strengthened when the two spectra are exactly superposed. Thus the arc presents us with a medium which emits the rays D on its own account, and which at the same time absorbs them when they come from another quarter. To make the experiment in a manner still more decisive, I projected on the arc the reflected image of one of the charcoal points, which, like all solid bodies in ignition, gives no lines; and under these circumstances the line D appeared to me [dark] as in the solar spectrum."

In 1855 M. Angström published a memoir, remarkable in many ways, and to which we have already had occasion to refer. In speculating upon the origin of the absorption of light by bodies, the author observes:—"As according to the principle of Euler [Quemadmodum (ergo) corda tensa a sono ei, quem ea edit, æquali vel consono concitatur, ita particulæ illæ minimæ in superficie corporis opaci sitæ, a radiis ejusdem vel similis indolis, contremiscere, pulsusque undique diffundendos producere valebunt—as correctly applied by M. Angström] a body absorbs all the series of oscillations which it can itself assume; it follows from this that the same body, when heated so as to become luminous, must emit the precise rays which, at its ordinary temperature, are absorbed." This proposition, it was added, is in so far true as the diversity in "the condition of the heated body, as regards elasticity, [which] is altogether different from the state in which the light is supposed to be emitted," may be neglected; but then it would have been more correct at once to refer the emitted light to the power of absorption actually obtaining under the same conditions, instead of at common temperatures. Adverting further to the spectra of the electric spark as compared with the solar spectrum, M. Angström observes that, "regarded as a whole, the first produced the impression of being the reverse of the other. I am therefore of opinion that the explanation of the dark lines in the solar spectrum embraces that of the luminous in the electric spectrum." Thus, by the observations of M. Foucault, conjoined with the above explanations, the origin of the dark lines in the solar spectrum was accounted for, supposing the two had been brought mutually to bear. Like M. Angström, Prof. Kirchhoff was not aware of M. Foucault's experiments when, in 1859, he published the following:—"On the occasion of an examination of the spectra of coloured flames . . . I made some observations which disclose an unexpected

explanation of the origin of Fraunhofer's lines, and authorise conclusions therefrom respecting the material constitution of the atmosphere of the sun. . . . I formed a solar spectrum by projection, and allowed the solar rays concerned . . . to pass through a powerful salt-flame. If the sunlight were sufficiently reduced there appeared in the place of the two dark lines D two bright lines; if, on the other hand, its intensity overpassed a certain limit, the two dark lines D showed themselves in much greater distinctness than without the employment of the salt-flame. The spectrum of the Drummond light," originally continuous when transmitted through a salt-flame, exhibited "two dark lines of remarkable sharpness and fineness, agreeing with the lines D of the solar spectrum." All this was similar to the previous observations of M. Foucault; but, whilst the latter drew no inferences from his facts, M. Kirchhoff immediately concluded from his observations "that coloured flames, in the spectra of which bright sharp lines present themselves, so weaken rays of the colour of these lines, when such rays pass through the flames, that in place of the bright lines dark ones appear as soon as there is brought behind the flames a source of light of sufficient intensity." And he adds with emphasis:—"I conclude, further, that the dark lines of the solar spectrum which are not evoked by the atmosphere of the earth, exist in consequence of the presence, in the incandescent atmosphere of the sun, of those substances which, in the spectrum of a flame, produce bright lines at the same place. . . . The dark line D in the solar spectrum allows us, therefore, to conclude that there exists sodium in the sun's atmosphere. Brewster has found bright lines in the spectrum of the flame of saltpetre at the place of Fraunhofer's lines A, a, B; these lines point to the existence of potassium in the sun's atmosphere."

Already, from the researches of Leslie, of the year 1804, and still better from some observations by Mr. Balfour Stewart published in 1858-9, the proportionality between the absorptive and emissive powers of substances for rays had resulted,—at least so far as radiant heat or invisible rays are concerned; and, whilst a mechanical explanation, applicable in general, of this law, as we have seen, had been deduced by M. Angström, from a hypothesis of Euler's, Mr. Stewart, in 1860, had roughly proved the same to hold good also in the case of visible rays or light. M. Kirchhoff has attempted to furnish a strict mathematical demonstration of the necessity of its validity; and whatever opinion may be held of the value of this proof, the law itself is sufficiently

corroborated by the facts discovered by himself. By comparing the dark lines of the solar spectrum, of which he has formed a new and highly elaborate map, with the bright lines in the spectra of metals volatilised by the electric spark, M. Kirchhoff has traced many other such coincidences as have been above referred to in the case of the sodium and potassium lines; and he believes he can consequently assert with certainty the existence in the sun's atmosphere of the elements iron, calcium, magnesium, sodium, chromium, nickel, cobalt, barium, copper, and zinc, whilst gold, silver, mercury, aluminium, cadmium, tin, lead, antimony, arsenic, strontium, lithium, and silicium appear to be wanting. According to his later investigations a considerable number of other elements, besides those above mentioned, are present in the solar atmosphere. The spectrum of iron is remarkable for the great number of lines which it exhibits, and of these sixty were found to coincide with dark lines in the solar spectrum. Allowing for a possible inaccuracy in his observations, M. Kirchhoff makes out the probability of his having confounded nearly coincident lines with one another in 60 concomitant cases to be equal to 1 divided by 1, followed by 18 noughts—that is itself as good as nought. This, it is expected, will bring home conviction to the minds of the most doubting. Yet the inference from these coincidences to the necessary existence of iron in the solar atmosphere (or conversely) must remain inconclusive, if not inconsequential, as long as (besides the relation of the spectra of compounds to those of their constituent elements) another question is not cleared up, of which M. Kirchhoff justly observes that it is one "of great interest"—namely, whether the observed coincidences of lines belonging to two different substances, of which he has noticed some eleven, are real or apparent ones.

Another important question, although without immediate bearing upon the point mooted, is whether a really elementary body is capable of emitting several rays differing in quality, except such whose wave-lengths bear to each other the relation of harmonics, as indicated in the theory of Angström and Euler. An incidental result of the researches of M. Kirchhoff has been, or at least probably will be, the relinquishment of the somewhat fanciful notions concerning the internal structure of the sun hitherto current, and the re-adoption of the much more rational views of Newton and Galileo. Newton asked, "Are not the sun and the fixed stars great earths vehemently hot . . . whose parts are kept from fuming away, not only by their fixity, but also by the

vast weight and density of the atmospheres incumbent upon them ?"—and Galileo had even gone further, and declared sun spots to be clouds in the sun's atmosphere. M. Kirchhoff, in order to explain the dark lines in the solar spectrum,—which he severally refers to the absorption of such gaseous substances as at the same time emit rays of the same quality as they absorb, but of much less intensity,—finds it necessary to revert to these older views, which, on their part, are in so far corroborated by his terrestrially observed facts as the theory which he builds upon them is well founded. That such is the case seems to be open to little doubt.

Reviewing the whole of the facts stated in this paper, the ample recognition which Profs. Kirchhoff and Bunsen have received for their researches will appear well deserved. Yet philosophers may congratulate themselves that discoveries of this nature should have been brought forward by persons of such eminent or distinguished names, for—owing to the openings that they afford to scepticism—if first published by some novice they would have been either unduly assailed, or, as is not altogether unlikely (for such things have happened ere now), perhaps even ignored.

II. THE WORLD OF THE POETS.

A WRITER in this Journal (1879, p. 271), when discussing the question of the perfection of Nature, took occasion to examine some of the views of the world and of its constitution which still prevail among men of culture. Looking a little farther in the same direction, it may be not uninteresting to scrutinise the pictures which imaginative writers draw of the world as they would wish it to be. It may perhaps strike us as somewhat singular that the very class of men who are so ready to pronounce Nature perfect, and who can scarcely remain within the bounds of ordinary courtesy if anyone venture to maintain that a plant or an animal is ugly,—to question the utility of any organic species,—to term certain scenery devoid of beauty, or indeed in any other way to withhold his sweeping approval from things as they are, should yet be, on their

part, so ready to improve upon this supposed perfection, and thus to paint the lily and gild the refined gold. In all these imaginings, whether they refer to a golden age in the distant past, or to a "good time coming" in some far-off futurity,—whether they are idealisations of this earth of ours, or dreams of some other and better world,—there is a singular sameness. The poets of the past and of the present, while feeling that much around them does not answer to man's wishes, seem yet to have formed but very crude notions as to where the mischief lies. Their amendments on reality are impracticable and inconsistent, and could they be carried into effect would often prove true calamities.

Among the natural phenomena complained of by the tuneful and irritable race is the night :—

> "Fair wert thou with the light
> O'er thy blue hills and sleeping waters cast
> From purple skies ne'er deepening into night."

wrote an English poetess in an ode to Elysium, and the same idea in substance recurs in many other "lays and prose imaginings." We may well ask, at the outset, whether, in point of mere beauty, the loss of sunrise, of sunset, and of moonlight would be any great gain to the world? Surely many effects, priceless to the poet and the artist, and indeed to the æsthetic sense of all of us, would thus be rendered unknown, and even inconceivable!

But more, without a complete modification of constitution, the nature and extent of which we cannot imagine, neither man nor beast would be benefitted, or could fail to be injured by one unbroken exposure to the light of day.

Nor must we forget the part which the stars and the moon have played in the intellectual training of our race. Had we lived in constant daylight, knowing no heavenly body save the sun, not merely the science of astronomy would have been wanting, but the development of mechanics and physics would have been gravely affected. The theory of universal gravitation would scarcely have been established; the speed of light would not have been measured, or, rather, the fact that it has a rate of motion would probably have escaped us. Our conceptions of time would be very vague, deprived as we should have been of the very notions of the day and the month.

How perpetual daylight was to be obtained we are not informed. In a world revolving on its axis in presence of a sole source of light, day and night must necessarily alternate. In systems lighted up by twin-suns the nights might be

very much shortened, but even there they could not entirely vanish.

To what extent a planetary body can be self-luminous, and yet sufficiently cooled down to be the abode of organic life of a type even remotely approximating to our own, we cannot venture to guess. There is, however, one conceivable arrangement by which perpetual daylight might be secured over a vast extent of surface. Suppose, instead of planets revolving round the sun at different distances, there were one broad belt of solid matter. The concave side of such belt would be constantly irradiated, and might be the theatre of life. Or, going farther still, suppose the sun fixed in the centre of one vast hollow sphere, with a radius of say 100 million miles. In this manner all his heat and light would be utilised. What a glorious flora and fauna might be developed in such a world! Is it not possible that the dark masses supposed by some to exist in different portions of the heavens may be the outer shells of such systems?

More desirable and more feasible than perpetual day is perpetual summer, or at least the absence of low temperatures. Such a state of things exists even now in many parts of the globe, and in the Eocene and Miocene epochs it was probably universal. If the human species had begun its career so early the traditions of a golden age, of a Saturnian reign, of a lost paradise, might have a solid physical basis. We may imagine with what regret our forefathers, struggling with the horrors of the Glacial epoch, would dwell on the memories of the good old times when Central Europe enjoyed a semi-tropical vegetation, and when even Spitzbergen was clad with luxuriant forests. But not content with painting the lost Miocene epoch as it really was, they would idealise it, and, in addition to its perennially mild climate, they would invest it with other and often impossible attractions.

Thus among the foremost charms ascribed by the poets to their better worlds are "never-fading flowers." The trees bud, the blossoms expand, but, instead of withering and falling off, they are to become permanent. Yet clusters of luscious fruits are all the same included in the picture. The absurdities here implied are of a most complicated nature. The flowers are, of course, supposed to exist not in order to fulfil any function of vegetable life, but merely for the delectation of man. How the fruits are to be formed and to grow without the displacement of the blossom is difficult to comprehend. Still more are we perplexed to

conceive of tissues so frail and delicate as flowers, and whose beauty depends in no small degree upon that very delicacy becoming proof against the influences of air and light. We may suppose storms, winds, and frosts banished, but even in the absence of all these ruder agencies we find flowers fade,—in one sense from the continued action of the very forces which have called them into existence, and which thus in succession play the parts of Brahma and Siva, the creator and the destroyer; but more strictly this fading and decay must be regarded as the advance to a higher state of development, like the falling off of the gills and tail of a tadpole, or the loss of the milk-teeth of a child.

But a still greater difficulty remains. Unfading flowers mean an arrest of the transformations and the circulation of matter. If every tree and plant is to put forth constantly fresh flowers, and, we presume leaves, none of which are to wither and be re-converted into their crude elements, a continual drain upon the soil must take place which would sooner or later end in exhaustion, unless the supply of plant-food were absolutely infinite.

Another feature of the idealised world is the disappearance of all carnivorous species, or their conversion to vegetarianism. Rapine and bloodshed are to cease, and the reign of universal peace is to be inaugurated. Here it may be objected that the mere elimination of carnivorous species would be very far from securing unbroken peace. Herbivorous animals fight abundantly and most viciously among themselves, and are not rarely guilty of "unprovoked assaults" upon other creatures. Very few male phytophagous beasts are to be trusted if they possess sufficient strength to be formidable to man, and some—such as the Cape buffalo—are as dangerous as the lion or the tiger. Hence a mere change of diet must be pronounced a very small reformation.

But further: if it is painful to our feelings to see or to know that at any moment numbers of animals—some of them harmless, beautiful, or interesting—are struggling in the grasp of enemies, or being actually devoured, is it not equally unpleasant to see the most charming flowers mutilated by slugs or earwigs, or trodden in the mire by oxen? Must we not regret when stately trees are stripped of their foliage by locusts or cockchafers, or when their stems are riddled through by the larvæ of *Cossus ligniperda?* Is it pleasant to see shrubs barked by hares, browsed down by goats, or uprooted by swine? It may, indeed, be contended that vegetables are not conscious of the injuries they suffer.

Granting, for argument's sake, this undemonstrated proposition, we may still doubt whether a considerable portion of the animal world do not share this unconsciousness. Further, so long as beautiful objects are destroyed, and we are conscious of such destruction, we cannot help experiencing regret, whether the beings that thus perish are sensitive or apathetic.

This elimination of the Carnivora, or rather the continued existence of the Herbivora, is also out of all harmony with the notion of deathless flowers. To what good end is the rose or the lily to be exempt from spontaneous withering, if it is still liable to be destroyed by beasts?

Some dreamers have gone a step further, and have banished from their ideal worlds all animals save man only, who is to be the sole spectator and enjoyer of the flora of the golden age. Even, however, if we overlook the important part which many insects play in the fructification of flowers, it seems to us that woods and gardens without birds and bees and butterflies would strike us as dead and dreary. We should miss the chirping and the warbling up among the branches, and the mellow hum over the flower-beds, and the glance of many-tinted wings in the sunlight; and the moment we restore these welcome sights and sounds the old game of eating and being eaten re-commences, save indeed on one supposition, which has not, we believe, found its way into imaginative literature. A world is conceivable where both animals and plants should draw their support directly from inorganic matter without preying upon each other. Whether such a world exists, or ever will exist, are questions beyond our reach. It would be no inconsiderable step in that direction if synthetic chemistry, which even now gives us alizarine without the aid of the madder-plant, should some day succeed in producing starch, sugars, oils, albumen, casein direct from their elements without the intervention of animal or vegetable life at all. Strange to say this harmless suggestion, having been once brought forward in conversation by a friend of the writer's, was denounced by a reverend gentleman present as "revolting blasphemy."

Another feature of the "better world" is immortality. Sometimes men alone, but more commonly all creatures, are described as exempt from the pains and the bereavements of death. But the poets have forgot one important condition. In their deathless world reproduction is still assumed. The plants are still to flower and to fructify. The animals, from "the small gilded fly" up to man, are still regarded as sexual.

Were such the case neither this world nor indeed any world could, for any length of time, supply materials for the frames of its organic population, or even room for them to occupy. Reproduction involves death as its necessary condition. Hence we are told that in the life to come mankind shall "neither marry nor be given in marriage." That in the present state of things the longest-lived animals arrive most slowly at maturity, and produce the fewest young at a birth, is almost a trite remark.

Thus, with the exception of the milder climate once doubtless possessed by our globe, the other features of the golden age are such as never could have existed, and may even in most cases be pronounced mutually contradictory. The origin of such traditions of the past, or anticipations of the future, is easily explained, if, as above said, they are idealised memories of the Miocene days. But that man actually existed in that epoch, and existed in a condition so far advanced as to hand down and to idealise legends, is utterly unproven. If our species is of more recent development, these stories of a better world do but reflect the unsatisfied longings of all generations.

B. B.

III. EXCEPTIONAL SEASONS AND WEATHER PROPHECIES.*

SOME time ago we were led, by the sunless summer of 1879, to discuss the well-known theory which traces a connection between weather-cycles and the periodicity of the sun-spots—a term of rather more than ten years. Whilst unable to accept this hypothesis, neither did we see our way to its definite rejection. In speaking of the lack of heat which characterised that summer we fell, however, into an error which we are anxious to rectify. We ascribed the visitation which has brought ruin upon so many of our farmers, and has occasioned in the United Kingdom alone a loss for which a hundred millions of money would very poorly compensate to a predominance of the polar current. Such was not the case. The perplexing feature in

* "The Anomalous Season." Journal of Science, July, 1879, p. 457.

the season was persistent cold brought by southerly and south-westerly winds. Whether there may have been a polar upper current which chilled the atmosphere, and precipitated the moisture held in suspension by the equatorial current, we are unable to state.

Latterly a totally different theory has been brought forward by Mr. R. G. Jenkins, F.R.A.S., which leaves the sun-spots and their periodicity out of the question. It has been proved by the Astronomer Royal that the planet Venus exerts a disturbing effect upon the earth, so as materially to interfere with its orbit. This action appears to follow a cycle of eight years, and in it Mr. Jenkins seeks for an explanation of the waves of cold which he considers occur on an average every eight years. Another consequence of this hypothesis, if correct, is that for the next forty years the temperature will fall below the average, whilst during the past forty years it has been in excess.

Mr. Jenkins concludes, further, that every twelve years a wave of unusual heat sweeps over the earth nearly contemporary with the arrival of the planet Jupiter in perihelion, and that we are on the eve of such a great heat-wave.

We will endeavour to trace in how far these views are in harmony with past experience. To find an unquestionable starting-point for the series of warm years we can do no better than take a season still fresh in the memory of all the middle-aged portion of the public—the glorious year 1868, characterised by its July harvest. Taking twelve-year intervals for the last sixty years we should have the following succession:—1820, 1832, 1844, 1856, 1868, and 1880. How does this series agree with facts? As far as we have been able to trace out, the years marked by exceptional warmth were 1818, 1825,—both of which brought July harvests,—1854, 1857, 1858, 1868, 1869, and 1870. Whether there was any unusual heat in 1844 we cannot ascertain. As we pointed out in the article above referred to the summer of 1857 was beautifully dry and warm, and was followed by a winter free from snow and ice, save a short attack in February, 1858. The succeeding summer was at least equal to that of 1857, and the only frost in the ensuing winter was from November 12th to 17th. After this open weather continued. This long continuance of favourable weather is not separated from the next warm year by a twelve years' interval.

The season of 1868, again, was immediately followed by two other years somewhat inferior, but still very much

better than any seasons we have since experienced. As for the year whose end is now approaching, no one can pronounce it exceptionally warm, though it may seem favourable in comparison with 1879. It has brought no sultry nights, and the proportion of northerly and north-easterly wind has been uncommonly high. Winter may be said to have set in on October 20th, and all appearances seem to point not to a heat-wave, but to a winter of exceptional severity.

We turn next to the cold years. Mr. Jenkins gives the following series:—1829, 1837, 1845, 1855, 1863, 1871, and 1879. The remarkably bad years on record are 1816, 1845, 1855, 1860-61, 1871, and 1879.

We are bound to admit that here theory and experience coincide far better than in the case of the warm years. Concerning 1829 and 1837 we can learn nothing; 1845 and 1855 were both wretched, and in 1871 the snow which had fallen a few days before the end of 1870 lay unmelted into February, whilst the spring and early summer were unfavourable. August and September were, however, dry, warm, and sunny. But 1863 breaks the series. It cannot for a moment be compared with 1860-61. Christmas-day, 1860, was ushered in by probably the most intense cold ever registered in England since accurate thermometers became available. Well-grown apple-trees, and even oaks of a yard in circumference, were killed. The havoc among the ornamental trees and shrubs in Chatsworth Park was terrible. The succeeding spring and summer—called so merely by courtesy—were even more ungenial than those of 1879: perhaps less wet, but certainly colder. In November we saw the corn over extensive tracts of country rotting where it had grown.

The bad season of 1816, again, cannot be harmonised with 1829 by any multiple of 8. It will also strike the reader that the interval 1845 to 1855 is one of ten, not of eight, years. If, then, we add to 1845 2×8, we are brought to 1861, the really worst season. It might, therefore, be asked whether any cause could have retarded the cold-wave so that it reached the earth in 1855 instead of 1853, which latter was, however, a most ungenial year. We doubt, meantime, how far the expression a "wave of cold," as applied to the regions of space, is justifiable. And this doubt leads us to another very important consideration: do these warm and cold years extend simultaneously over the whole earth? If not, it is surely hazardous to assign them to cosmic causes. It is understood that the season of 1879,

so disastrous in Britain and the west of Europe generally, had a very different character in the United States, where the harvest was exceedingly abundant. The question whether the whole earth in 1879 enjoyed less solar heat than in 1868 has scarcely been asked, and assuredly not decided. Suppose any change in the regions of space interfered with the action of the sun's rays upon the earth, or caused the heat which the planet absorbs to radiate away more freely, it is difficult to say how such a change, acting continuously for months, could bear upon Europe and leave Eastern America unscathed.

The periods of forty years alternately exceeding and falling short of the average temperature form another feature in the hypothesis of Mr. Jenkins. Have the years 1840 to 1880 been in any appreciable way superior to those from 1800 to 1840? We doubt it. The first-named period has brought us only one July harvest, and, on the other hand, a succession of bad seasons, 1872 to 1879 inclusive, such as are not often recorded in authentic history.

If we take *à priori* grounds we must certainly pronounce the eight years' cycle of Mr. Jenkins less probable than the sun-spot hypothesis. A change in the conduction of the sun's surface is much more likely to be a *vera causa*, as far as the earth's temperature is concerned, than a slight orbital perturbation. It may not here be out of place to remark that if Venus is the cause of these waves of cold the astrologers were fearfully mistaken in ascribing to her a benign influence.

We cannot here help referring to the predictions of an anonymous French meteorologist, which so far have proved but too true. He foretold severe winters for the years 1878, 1879, 1880, and 1881, the last being the culminating point, after which a series of favourable years were to ensue. As far as we remember he promised, after 1881, to reveal the principles upon which his forecasts are based.

IV. MODERN CYNOLATRY.

Dedicated to "Ouida" and Dr. Lauder Lindsay.

By Frank Fernseed.

A PLEA for Dogs?—and wherefore? Have they not privileges enough? Has not every one of them the indefeasible right by judge-made law to at least one bite of human flesh? Can the reader defend himself or his child against a canine aggressor—possibly rabid, without the risk, firstly, of assault and battery from its owner, and, secondly, of a prosecution by the "Royal Society for the Suppression of Cruelty to Animals," who, being rich and obstinate, may, if the accusation is dismissed by a sensible magistrate, "ask for a case" for a superior court? Have not dogs a practically unlimited right of trespass and intrusion everywhere, and of committing damage to property animate and inanimate? Is not the responsibility of the dog-fancier for the misdeeds of his pet simply null? Do we not find, in defiance of all regulations to the contrary, dogs introduced into railway carriages, tram-cars, and public gardens? What, then, more or further can these creatures demand, save, perhaps, the Parliamentary franchise.

It is fully admitted that in days bye-gone dogs have played a very useful part. So long as these islands were infested with dangerous beasts of prey, so long as cattle and sheep roamed in unenclosed forests and wastes, and so long as the criminal classes had not learnt the art of fascinating and silencing the fiercest and most vigilant mastiff, there was a very obvious reason for the "friend of man." But now all these conditions have passed away it surely becomes questionable how far dogs should be gerally tolerated in a populous and civilised country, except where it can be shown that they perform some real, definite service. Yet there exists a noisy party who, in addition to the privileges already mentioned, claim for these animals exemption from taxation, the abolition of muzzles and chains, and open, recognised admission into all places of public resort.

The arguments and appeals of these agitators are in their way interesting.

What, *e.g.*, must any sober-minded man of the world think of the following tissue of passionate fallacy? I do not say

sophism, for the writer, wild as are her statements, is evidently sincere:—

"The mischief, which, is ever done by our four-footed friends, is, after all, very small in its sum. All the dogs in great Britain and Ireland never slew in ten years as many human beings as one lead mine, one lucifer match manufactory, one railway company, or one refuse-choked river slays in a year. When human life is held so cheap that capitalists are allowed to pursue manufactures which are calmly shown by statistics to kill all employed in them before they can reach middle age, and whilst such manufactures are deemed quite honest and justifiable, though destroying human bodies with a frightful celerity and a mathematical certainty, it it is unutterably absurd to see the whole hue-and-cry of a nation out against dumb* animals, whose uttermost possible average of crime is that one in a million may bite one out of ten millions."

Who can fail to draw the obvious distinction that in a settled country like England dogs are, to say the least, useless and exist merely for the caprice or amusement of their owners? On the contrary, the industries to which "Ouida" takes exception are useful, if not absolutely necessary, and could not be dispened with except at a great loss. A country without dogs would neither be the poorer nor the less happy. A country without railways would suffer far greater evils than the loss of the few lives which they sacrifice, and which, in proportion to the number of travellers, is smaller than was the case in the old days of coaching.

A refuse-choked river is certainly neither pleasant nor profitable, but, as all municipal authorities know, it cannot be got rid of except at the cost of a heavy outlay.

But "Ouida" overlooks a further distinction which is by no means to the advantage of her clients. No one is compelled to work at any unhealthy employment; those who do so act of their own free choice, and usually receive higher wages in consideration of the risk. Those who reside near a lead-mine can, if they dislike the neighbourhood, remove elsewhere. A riparian proprietor, if injured in his health, his pocket, or his æsthetic sense by a refuse-choked river, can obtain an injunction against those who pollute the waters. But how, when, or where, can we avoid the dog nuisance? "Gentle shepherdess tell me where?" Nay, is not the very gist of "Ouida's" plea to demand the removal of all the present nominal restrictions on their movements and actions?

* What is the exact relevance of the term "dumb" in this connection?

Here are the very words:—"Let the Legislature *forbid* muzzles and chains; let public parks in all cities, at least for certain early hours of the day, be open to *all* dogs for exercise and liberty."

And now as to the "utmost possible average of crime" of which dogs may be guilty. I find it on record that in the first six months of the year 1865 no fewer than 354 persons suffering from bites by dogs were treated in the London hospitals. This would give for the whole of the year 708, and if we suppose,—which is surely no exaggerated estimate—that as many more were treated in private practice, we shall have in round numbers a yearly total of 1400 persons injured by dogs in London alone. Or, taking the entire population of Great Britain and Ireland at ten times that of the metropolis, we find the gross number of the sufferers rise to 14,000 yearly;—decidedly more, I submit, than "one out of ten millions," and certainly more than the worst-managed lead-mine, or lucifer-match manufactory, or railway company injures in the same length of time, leaving "ten years" out of the question.

Nor are these injuries always trifling. Before me lies the account of a deplorable case which occurred at Salford on the 9th of July last. A large black Newfoundland dog, belonging to a grocer in Howard-street, suddenly sprang over the wall in front of its owner's premises, ran along the street, seized a little girl named Caroline Cobb, and began worrying her. Two men, after a great deal of trouble, succeeded in driving the brute off. The child was severely wounded upon her neck, face, and body, and was disfigured for life.* It was stated that the dog had on previous occasions bitten people, and frequent complaints had been made to the owner about its savage character. The usual defence—in my opinion utterly irrelevant save as a mere legal quibble—was attempted, to wit, that the dog had never, to its owner's knowledge, bitten any person. The judge gave a verdict for the plaintiff for £30 and costs. I should like to ask the mothers of England whether a mere money penalty, which was all the court could inflict, should in such a case be regarded as at all adequate? In my opinion the destruction of the noxious brute and a few months' hard labour for the owner would be certainly not too severe a punishment.

* What worse could happen in a country over-run with wolves? Moreover, he friends of the maimed child might shoot a wolf, but the law does not allow them to shoot its equally dangerous cousin. If they poison it the newspapers call them "cowardly assassins."

A few such sentences would protect our children from being worried by ferocious beasts for a century to come.

I have termed the plea that the dog in question had never before, as far as its owner was aware, made an attack upon any person, "irrelevant." The fact is that, save to those whom it knows, every dog of any considerable degree of size and strength must be regarded as dangerous. No one knows when or against whom it may suddenly conduct itself according to its true nature, as a beast of prey. Surely, then, those who persist in allowing such creatures to frequent public places should be held criminally responsible for any outbreak that may occur.

But it will be said these 14,000 persons, or one in about every 2300 of the entire population of the United Kingdom, thus wantonly maimed year by year for the sake of the dog-fanciers' amusement are only wounded, not slain outright.

I will turn, therefore, to the official statistics of hydrophobia in England and Wales. The number of cases, or, in other words, of deaths, for the eleven years 1866 to 1876 inclusive is given at 387, or on an average 35 yearly! Now, as the population of South Britain does not greatly exceed 25 millions, we have here one person done to death by dogs not out of every "ten millions," but out of every 700,000,— a somewhat different result.

During the past year no fewer than 103 persons were bitten by mad dogs in Paris and its suburbs. Of these 30 are known to have died from hydrophobia. If we estimate the population of the French capital at two millions, this gives a death-rate from this one utterly gratuitous cause of 1 in 66,000! Five hundred mad dogs and a score of mad cats were destroyed by the police in the course of the year. In the months of July and August alone 4730 stray dogs were taken to the *fourrière*, and all but 200 were killed. In consequence of this most "judicious butchery," if Dr. Lindsay will permit me thus to modify his utterance, there has been a great reduction in the number of persons bitten and in the death-rate from hydrophobia.

I am aware that a most fantastically impudent plea has lately been advanced in opposition to the plain moral to be drawn from these facts and figures. We are told that if persons are bitten by a dog and die subsequently with the well-known symptoms of hydrophobia, it is merely the effect of their "excited imagination."

Had they strength of mind to repress their fears, no harm, we are told, would ensue! In reply to this lamentable sophism, I may point out that cattle, sheep, and horses after

having been bitten by dogs in the state commonly known as "mad," display the very same symptoms. Are we to ascribe this result also to the workings of a morbid imagination? Many human sufferers, so far from being tormented with constant apprehensions, are recorded as having quite forgotten the original bite till the approach of the deadly symptoms recalls it their memory. How, again, would dog-worshippers explain away the outbreak of *rabies* in animals, *e.g.*, rabbits, experimentally inoculated with the virus of the dog? Is here also imagination at work, or have we "epileptic convulsions."

Another device of the dog's advocate is to assert that *rabies* and, indeed, irritability and the tendency to attack passers-by, are produced by confinement, muzzles, and chains, and that were the curs allowed to roam about at their own sweet will and to obtrude themselves everywhere, these evils would vanish of themselves. This is, to say the least, a daring assumption. The wolves of the Continent and the jackals of India enjoy their full freedom. Yet rabies is far from rare among them. The dogs which invest every village on the frontiers of Poland know nothing of muzzles and chains. Yet this freedom does not sweeten their tempers or prevent them from attacking every stranger—especially if respectably dressed—who appears in the neighbourhood. Very similar is the behaviour of the large and powerful mastiffs who, in the Carpathians, are kept by the Slawack herdsmen as a defence against wolves. Probably not one of them has ever been tied up in his life. But woe to the unarmed stranger who happens to come within a quarter of a mile of these ferocious brutes.

Even if we, for argument's sake, admit that some of the cases of supposed hydrophobia in man may be partially set down to the workings of a morbid imagination, and that some dogs destroyed as rabid may have been merely suffering from "distemper," I do not see that this in the least alters the case. Had the persons affected never been bitten, the fatal symptoms, however explained, would never have arisen. Had there been no dogs straying about it is equally certain that the victims would never have been bitten. Surely the man who, owning a dog, allows it liberty when in a state capable of communicating rabies, incurs morally—though, unfortunately, not legally—a responsibility as great as if he were to discharge a rifle along a public thoroughfare. Indirectly, but not the less certainly, he trifles with the lives of his neighbours, not out of any necessity, but for a mere whim. And yet he can dare to talk about justice!

Dr. Lindsay pronounces the destruction of dogs for "*mere* biting" an "injudicious butchery," and laments the condemnation of the stray dogs of Glasgow after the occurrence of three cases of hydrophobia in that city.

I cannot agree with him. It is only in case of man that we can truly say, "better ten ruffians should escape than that one unoffending citizen should be imprisoned." With the lower animals, as with inanimate matter, we must invert this principle. Better a thousand bales of suspected, though harmless, merchandise should be burnt than that one bale should pass free and introduce the plague into our midst. Better, were it possible, that all the serpents in India, many of whom are perfectly harmless, should be extirpated than that one cobra should survive. No one questioned the wisdom or the perfect justice of stamping out the cattle-plague by destroying every herd among whom the scourge appeared, though many among them were not attacked, and might possibly have remained unaffected. Yet this was a case where property only, and not human life was at stake. Surely, then, we are *a fortiori* justified in destroying the dogs of a district if we have reason to suspect that *rabies* exists among them. The fewer curs remain, the less opportunity is there for the spread of the disease. A man attacked by any animal has, I submit, a natural and indefeasible right to destroy it, and if the law interferes with this right in the case of tame animals it should merely undertake the task of destruction on his behalf.

But the annoyance inflicted upon the public by dogs, or, more accurately speaking, by dog-owners, is not confined to biting. I object—and I submit with full right—to be barked at when going peaceably about my business. I object to be deafened by one of these "noble animals" which runs yelping after a public conveyance in which I am travelling. When taking my walks abroad I object to find a dog smelling at me and wiping his snout upon my clothing.

As we hear so much of the docility and intelligence of these animals, surely their owners might teach them not to interfere with passengers in public thoroughfares. I do not learn that any attempt is ever made in this direction, or that the dog-owner ever conceives that he is, by permitting and occasioning such conduct, infringing upon the rights of his neighbours.

Nor must the injury to property occasioned by dogs be lost sight of. Perhaps, indeed, I ought to have given it the precedence, since in England it is protected far more carefully

than is the human person, and since an attempt was recently made to diminish even the slight defence which the latter at present enjoys. I refer to Mr. Hopwood's bill for giving the ruffian and the "corner-man" the option of paying by weekly instalments the forty shillings fine which English law deems a sufficient penalty for maiming and perhaps crippling for life some person against whom he has no cause of quarrel.

I will for the present pass over such minor mischief as chasing and killing poultry, ravaging flower gardens, and polluting merchandise placed at shop doors. But the destruction of sheep is too serious to be overlooked. In the State of Georgia as is learnt from official documents, no fewer than 28,000 sheep are worried by dogs in one year, the consequence being that in many districts otherwise suitable, sheep-farming is abandoned. In the whole of the United States the annual loss from this source is estimated at upwards of a million dollars! This grievance has even attracted the notice of mechanicians, who have sought to devise protective collars, the neck being the part generally attacked with the object of drinking the blood from the large arteries.

In England the damage experienced is smaller because we have a substantial—though in my opinion an insufficient—dog-tax. "Ouida," it appears, would make the tax merely nominal, and would thus expose our flocks to increased perils. Even at present farmers have too often good reason to complain. It is very satisfactory to learn that in consequence of the havoc committed in their neighbourhood, Messrs. Newton, Chambers, and Co., of the Thorncliffe Ironworks and Collieries, have issued a notice that they will not employ any persons, or allow any tenants to occupy their houses, who keep dogs. It is to be hoped that this example will be followed by other iron and coal-masters.

Few persons ever take into consideration the national cost of dogs. The number of licenses granted last year in England was 1,238,867, and in Scotland 153,309, making in all 1,392,176. It is no exaggeration to suppose that the unlicensed curs must swell the total number to a million and a half. Each of these "friends of man" will, on a very low estimate cost in food 9d. weekly,—probably more, as dogs are decided gluttons—or 39s. yearly. Hence, without taking any account of the waste and loss which he occasions, the "British dog" costs the country in round numbers three millions sterling annually! Is the game really worth the candle? Does any benefit at all commensurate with such a sum accrue from

dog-keeping? Might not those who cry out for "retrenchment and reform" find here an appropriate point upon which to fix their attention?

It is small consolation to learn that there is, at any rate, one country which exceeds us in this phase of waste. America has been congratulated on the fact that she has not to maintain a "vast standing army." But in place thereof she cherishes dogs to the estimated number of eleven millions, and, if our former suppositions are correct, pays for them the enormous sum of 22 millions sterling annually. Let those who doubt whether dogs are proper subjects for taxation remember that but for the dog-tax we should no doubt be similarly over-run.

When the advocates of the dog find themselves encountered by the irresistible logic of facts, as far as the danger to mankind and the economical worthlessness of their clients are concerned, they have recoure to some most curious arguments. In the first place comes the "poor man" plea. "Ouida" saith:—"Let not the poor man be made to think that a dog is a luxury of the affections (!) only possible for the rich; let not the poor man be taught to see that to have a pet for his children is a greater crime and one more heavily punished than wife-beating or bestial drunkenness."

It is remarkable how the poor man is "trotted out" whenever a nuisance is to be upheld or a folly defended. When intra-mural interment was first attacked we were told that it would be cruel to rob the "poor man" of his "nook in the parish churchyard." The drift of Mr. Hopwood's bill, above referred to, was that the "poor man" as well as the rich might enjoy the occasional luxury of committing a wanton assault without having to go to prison.*

Again, "Ouida" asserts that "nothing is surer to humanise the heart hardened by toil and privation than the innocent affection of a dumb animal." In the like vein, when it was last year proposed to extend the dog-tax to Ireland, a certain "honourable" member—Mr. Biggar, if my memory does not fail me—was very eloquent on the humanising influence of the dog, and when reminded of Bill Sykes and his bull-dog he waxed exceedingly indignant. Yet the Bill Sykes of fiction is but a poor shadow when compared with the Peace of fact,—robber, assassin, and dog-fancier. Let those who

* The admitted injustice of the present law would have been remedied by the total abolition of fines and the infliction of hard labour in *every* case of wanton assault.

would ascribe to the "poor man's dog" any elevating or humanising influence visit those towns and villages where the iron and coal trades flourish, and make good use of their eyes. Let them take note of the sullen, low-browed ruffians who lounge at the tavern corners or slink along the lanes, each duly attended by his lurcher, his terrier, or his "snap." Or, better still, let them on some public holiday, or even on a fine Sunday morning, go out to some open plot of ground in the suburbs. To give a single example, far from the worst of its kind, let our investigators go to Leeds on a Whit Monday, and take a stroll along the Knostrop Road, past the sewage works, and note the crowd there collected for the elevating sport of dog-racing, or perhaps of rabbit-worrying. If they do this they will form a fairly accurate notion of dog-keeping in humble life and of its tendencies. Yet Leeds is correct and refined in the manners and conduct of its people in comparison with some towns which might be easily named. We do not find the "poor man's dog" in the "home of taste," in the clean, trim cottage with flowers in the window-sill and books on the table. No, his place is amidst rags and squalor and scenes of brutality and drunkenness. The "pet" for the poor man's children, as "Ouida" terms the dog, is pampered at their expense. The dog-owner *is* the wife-beater and the drunkard. As a specimen of the humanising effects of dog-keeping we may takes the following gem, which every one who knows the manufacturing districts will admit is typical rather than exceptional:—

"To-day, at Willenhall Police Court, a locksmith, named John Henry Williams, was convicted of an aggravated assault on his wife. He had kept a racing dog, which slept in bed with him, and was fed off joints of beef, while his wife and family were scantily fed. For complaining of this treatment he beat and kicked her, breaking one or two of her ribs. He was sent to gaol for two months."

The parish-surgeon for the district of Brampton, near Chesterfield, lately reported at the meeting of guardians that many persons receiving out-door relief deprived their families of food that they might pamper dogs. It must not be supposed that these creatures are fed upon the scraps and leavings from the family table. The very reverse is often much nearer the truth. I have not merely heard of, but have personally observed cases where racing dogs are feasted upon prime cuts of meat, and where young children are robbed of their allowance of milk that it may be given to the "bull-pup." The "poor man's dog," which we are asked not to tax, is the cause and the symbol of suffering and privation

to thousands of women and children. To demand for the poor cheap food, clothing, shelter, instruction is wise and just. But, alas, when demagogues clamour for cheap folly, cheap vice, or cheap crime for the million!

The fact is that dogs, unless they can be kept entirely within private boundaries, have of necessity upon their owners an effect which is anything but elevating or humanising. They are, according to their advocate, "the most sensitive, vivacious, highly sensitive and animated creatures in creation." In other words, they are the most restless, meddling, obstrusive, and intrusive of brutes. Nothing, living or lifeless, are they willing to let alone. Hence the dog-owner who leaves his cur at liberty must either be constantly paying damages and apologising to his neighbours, or,—the more common alternative—he becomes utterly hardened, loses all sense of justice, and sets the injured parties at defiance, which, thanks to the absurdities of the law, is no very difficult matter. As an instance how indifferent dog-owners become to the rights of others, we may turn to "Ouida" herself. After recounting a case where, at the Lewisham Police Court, a certain person had been fined £10 because his retriever had bitten a woman, this writer, without a thought of pity for the wounded woman, exclaims that the owner, "*if fined at all*," should have been punished for not giving the brute more liberty! "Poor, imprisoned, tortured dog" is her exclamation! This is quite in harmony w th Dr. Lindsay's "mere biting," and leads me to believe that the exclamation ascribed to a lady of fashion whose dog had severely bitten a poor little child may be something more than a mere apologue.

It is perfectly true that many great men have been fond of dogs. But what strange propensities and freaks might we not justify by a perfectly analogous plea? Goethe, the type of sterling culture, as was Earl Lytton the type of electro culture, wisely said, man loves the dog because both are "erbaermliche Schufte." If the predilection for these animals has been handed down from barbarous times into an age of civilisation it is because they have readily made themselves the accomplices of man's vices. Cruelty—by which I understand the infliction of pain for mere amusement—would lack its chief agent were it not for the dog. I will merely hint that this is by no means the sole moral evil in which he is made instrumental.

Some day, if the progress of which our moralists dream is not all a delusion, dog-fancying will be regarded as one of the strangest and least creditable survivals from pristine

ages. Our descendents, after reading an accurate account of the manners and habits of the dog, will hesitate between disgust and laughter when they are told that in the Victorian era ladies who fancied themselves refined used to kiss these unclean and mal-odorous brutes.

"Love me, love my dog," say you? As the smaller of the two evils I will decline to love you!

V. FOG LORE.

TIME out of mind the fogs of England, and especially of that conglomerate which does duty as its capital, have been a favourite subject for Continental wits. We have even, in a thoroughly characteristic manner, joked over this unpleasant feature of our climate. But the subject is fast becoming too serious for jesting, and in place of recommending our friends to fit up circular saws in order to cut away the opaque and scarcely breathable atmosphere from before our doors we have taken alarm, and are beginning to arrive at the very luminous conclusion that "something must be done." For, during the last winter, we learnt from experience that a dense fog may last for longer than was formerly thought possible. We saw the traditional gloom of November last far into February, and we could not help concluding that, given the conditions of a low temperature and a windless season, London might possibly be wrapped for consecutive weeks or even months in a gloom far more perplexing than that of a starless night, and against which even the electric lamp is powerless. Hence those who—doubtless from the purest motives—are anxious to "improve" every occurrence, have not overlooked so convenient a topic. They have painted the destruction of this great city, or at least of the majority of its inhabitants, not by earthquake, pestilence, cyclone, conflagration, or war, but by a doom more weird-like and horrible than any of these scourges. A fog denser and more enduring than any yet on record is to settle down upon us. Traffic is to be rendered impossible. The existing stocks of fuel and provisions being exhausted the miserable people will be driven by cold and hunger to attempt their escape. Abandoning their houses

and possessions they will sally out into the suffocating air and wander through the endless labyrinth of darkened streets in the vain attempt to reach the open country, and, wearied and stifled, will at last lay down and die. Such, stripped of its more sensational features, is the prospect held up to our view. Unfortunately, whilst we may justly pronounce such a crisis very improbable, it is still within the verge of the possible.

Thus in 1783 a fog—to which we had occasion to refer in our last number*—is said to have covered nearly the whole of Europe for about two months. What security have we against the recurrence of such a phenomenon?

But without speculating on a visitation so horrible, even a winter such as that of 1879-80 is not a trifling evil. The hindrance to intercourse, whether by rail, river, or road, and the consequent general stagnation of business; the waste caused by the unusual consumption of gas, oil, and candles represent, together, a very palpable tax on the community. The average Londoner found his expenditure increased and his profits diminished. Most serious of all was the increased death-rate. The mortality from affections of the organs of respiration rose to a fearful point, and many who survived the fog had still received then a fatal injury. What wonder, then, that in prospect of another severe winter we are anxiously inquiring if there is no remedy?

To begin, then, what is the nature of fog? We are generally told that fog, mist, and cloud are one and the same phenomenon, differing merely in degree, or in position, and being in every case formed of a multitude of excessively minute vesicles of water, filled with air and suspended in the atmosphere. Such a collection of watery vapour when floating aloft in the air we call a cloud, and when it rests upon the surface of the earth a fog. But this view is not universally accepted, or rather, perhaps, it seems not applicable to all cases.

Dr. R. Angus Smith, F.R.S., describes† a fog which he observed at Reikjavik, in Iceland. The particles of this fog were exceptionally large, perfectly spherical and not hollow. It rolled along the streets of the town like a cloud of dust.

There are, further, two distinct kinds of fog, the wet and the dry. The former, like clouds and mountain mists, which are in reality the same thing, deposit a dew on the leaves of

* Journal of Science, November, 1880, p. 706.

† Memoirs of the Literary and Philosophical Society of Manchester, Series II., vol. 5.

plants and on the hair of animals, and are connected by imperceptible gradations with drizzling rain. On the other hand, the fogs of last winter were scantily charged with moisture, and many persons who found their breathing affected obtained relief by letting the steam of boiling water escape into the air of their rooms. A difficult question is the distribution of fog—the capricious manner in which it follows certain boundaries with little apparent reference to the direction of the wind or the character of the soil. Why should Tottenham-court Road and the surrounding district be often fairly clear, when to the east, south, west, and north the metropolis is plunged in darkness? Another peculiarity is the recent extension of fog to outlying localities which till lately were exempt from the nuisance. A friend who has lived at Sewardstone for about twenty years tells us that he never experienced anything worthy the name of a fog previous to the last two seasons.

But the fogs of all our large cities may be described, so far as their worst features are concerned, as man-made evils. Natural fogs, with the exception of some exceptional cases apparently of volcanic origin, are white, and even when densest transmit a considerable proportion of light. The yellow or black fogs of London consist largely of the products of the combustion of coal—in a word, they are in great part coal smoke, which in certain states of the atmosphere cannot escape. This fact is plainly proved by the peculiar smell which such fogs impart to the hair, the beard, and to woollen clothing, and by the taste which they leave upon the lips.

Hence we may see good reasons why the London fogs should be more severe than they formerly were and worse than those of any other city. In this "province covered with houses" there is a larger quantity of coal consumed than in any other district of equal size in the world. Nowhere else is there along with abundant coal consumption such a large tract where the free sweep of the wind is checked to such an extent by an endless array of streets.

Further, the very plan of the entire mass—London in the rational though not in the legal sense of the word—is as though purposely contrived to give fulll scope to fog and to prevent the free circulation of air. We have very few broad straight streets of any great length. The city is not cut up into quarters by boulevards and avenues.* Even when the wind is high it occasions sudden gusts and eddies instead of

* Suppose an earthquake—a first shock having given the alarm and further concussions momentarily expected. How few and far between are the localities where the public could take refuge!

the long continued sweep which would be desirable. The original plan of New York, when under Dutch rule, was, as Washington Irving tells us, laid out by the cows in returning from pasture. The plan of London has been committed to much worse animals,—building speculators,—who, on our modern principle of sacrificing the permanent welfare of the community to the momentary gain of the individual, have wrought a world of folly, hideousness, and abomination in general.

Having thus given a brief sketch of our present knowledge —or might it not better be said of our ignorance?—concerning fogs in general and London fogs in particular, we come to the vital point, the remedy. In all such cases there is reason to fear lest the "something to be done" may fail in every respect, save in adding to the very heavy burdens of the ratepayers.

There are proposals to prevent the formation of fog, to remove it, and, again, to alter its nature.

To effect the first-mentioned object an appeal has been made to the "unknown god" of modern days—electricity. We generally find that if some difficulty has to be overcome, the very nature of which is still obscure, it is proposed to apply electricity. But fogs are sometimes electro-positive and sometimes electro-negative. For the dispersion of the former class Dr. T. L. Phipson* considers that "it would be necessary to supply them with an abundant source of electro-negative electricity more quickly than the earth usually supplies it." Some propose a multitude of lightning-conductors in order to convey the positive electricity of the air down into the ground. Others suggest that trees should be planted wherever possible. It is certain that trees where numerous bring down wet mists in the form of rain, but we have not been able to meet with any proof of their efficacy in case of dry fogs. The question has also been raised in this connection whether asphaltic pavements, being poor conductors of electricity, may not promote fog by preventing a free interchange between the earth and the atmosphere. But the filthiest Macadamised streets of north and south-western London seem to suffer no less than the clean asphalted districts of the centre.

Another plan for dealing with fog is its mechanical removal. The originator of the scheme, who offers his process freely to the public, is Mr. W. A Gibbs, of Gilwell Park, Sewardstone, a gentleman honourably known for his agri-

* Familiar Letters on the Mysteries of Nature.

cultural drying machinery, for which he has received the gold medals of the Society of Arts and of the Highland and Agricultural Society of Scotland. He proposes to erect at the outfalls of the London sewerage systems at Barking and Crossness huge fans, to be set in motion by tidal power, and by their agency to cause an inrush of air into the sewers all over the metropolis, whilst fresh air would stream in from the country on all sides.

It will be admitted that to ventilate the sewers in this manner by the entrance of the air of the streets rather than by the egress of sewage gas would, if otherwise practicable, be a decided advantage, not merely in times of fog, but all the year round. It is also, we believe, conceded that the rise and fall of the tide might be made to yield power equal to the work required. But there are certain difficulties of a most formidable nature. The multitude of apertures by which air can penetrate into the sewers are so many that it becomes doubtful whether any conceivable exhaustion applied at Barking Creek would cause an in-draught into the sewers at Kensington, Pimlico, or Chelsea. It may also be asked whether the fog, if drawn out at the sewer mouths at Barking or Crossness, would not be carried back to the metropolis by the slight easterly current which generally prevails in foggy weather. We should very much like to see the experiment tried in some town of smaller extent than London where tidal power was available. It would be important to learn to what distance from the exhaustion-fans an inrush of air into the sewers could be traced.

There is another project of a far more gigantic nature, which, along with a number of other important objects, would have a two-fold action upon the fog difficulty. It has long been known that by boring to a sufficient depth water of a very high temperature can be obtained. The suggestion, therefore, lay very near that wherever a water supply sufficient in quantity and of a sufficient heat could be obtained entire towns might be warmed, as are now our conservatories by means of hot water pipes. Not only could dwelling houses thus be kept at a comfortable temperature all the year round without the combustion of fuel and the production of smoke, but the streets might in winter be so far heated that snow could not lie and that mud would be quickly dried up. This splendid project has, we understand, been to some extent reduced to practice in America. We should submit that a town thus warmed would be almost entirely free from fog, and that on three accounts. Ordinary fogs are phenomena connected with a very low temperature, and dissolve as the

heat increases. Secondly, the warmed streets would occasion a current of air; and, thirdly, the decrease in the consumption of coal would greatly reduce the production of smoke. That this project, if it could be carried out in London, would put an end to the existing coal monopoly might be even a greater benefit than the abolition of fog. Still, even if it could be demonstrated that an inexhaustible store of hot water existed at an accessible distance underground, we do not suppose that it would ever be utilised in the metropolis.

We have yet to consider the schemes for attacking fog by reducing the quantity and altering the nature of the fuel consumed. Here again we are tantalised by seeing things perfectly feasible from a physical point of view rendered impracticable by social peculiarities. All engineers who have studied the application of heat will tell us that at least three-fourths if not more of the warmth generated by the fuel consumed in ordinary English houses is simply wasted. Hence it would seem a very trifling matter to economise three-fourths of the coal employed, thus ridding the atmosphere of three-fourths of the smoke and soot-flakes, and rendering London a far more pleasant and sightly place of abode. But there is a barrier which cannot be broken Our dwellings are built for the open stove system, and cannot be altered without considerable outlay. Upon whom is this charge to fall? The tenant can scarcely be expected, in addition to overcoming the English prejudice in favour of an open fire, to sink a serious amount of money in modifying premises in which he has, in a vast majority of cases, only a brief and doubtful interest. The landlord, so far from bearing the expense, would probably not allow the alteration without an undertaking on the part of the occupier to restore the old open grate on the determination of the tenancy.

The very same considerations show the injustice and the cruelty of applying, as some have proposed to do, the Smoke Consumption Act to private houses. To the so-called working classes and to the poorer proportion of the middle class, who together form much more than half the population, such a decree would mean little less than ruin.

Another suggestion is to prohibit the use of bituminous coal, and to require, in its stead, the use of anthracite. This change could scarcely be effected without a serious rise in the preposterous prices now charged for fuel in London. At present the railway companies substantially refuse to carry coal save for a select circle of of individuals. But if only one coal-field, *i.e.*, that of South Wales, and one railway were

rendered available for the supply of fuel to the metropolis, it is surely reasonable so suppose that the present monopoly would be succeeded by one still tighter.

The use of gas as fuel would doubtless tend to the decrease of smoke, besides presenting not a few collateral advantages. But until the supply is placed in very different hands and the price reduced it will continue to play but a subordinate part.

Our prospects of relief from the fog nuisance are, therefore, about as bright as the fog itself. The means most likely to be adopted may safely be pronounced remedies worse than the disease.

VI. WORKING *V.* FIGHTING.*

By J. W. Slater.

"TAKEN with other recent scientific contributions, including especially the work of Professor Huxley 'On the Cray Fish,' the addresses of Prof. Agassiz on the echinoderms, and of Professor Le Conte before the Entomological Club, show a certain change of attitude, which naturalists are now assuming, on the subject of the development of vegetable and animal forms. There was a time, not long ago, when every voice was strident in advocacy of evolution. Now evolution is received as an established fact, and scientific effort is directed in explaining the many difficulties that lie in the way of the special working and applications of the hypothesis. This is the better and the truer spirit; for to increase our knowledge we need research not polemics."

Thus writes, most justly, the *New York Medical Record* (Sept. 18). But what has so long delayed biologists from entering upon this "more excellent way" and compelled them to spend twenty years in controversy often of doubtful

* Die Natürlichen Existenz-Bedingungen der Thiere: Von Karl Semper, Professor an der Universität zu Wurzburg. Leipzig: F. A. Brockhaus.
Island Life; or, the Phenomena and Causes of Insular Faunas and Floras. By Alfred Russel Wallace. London: Macmillan and Co.

merit? Not, assuredly, their own good pleasure. The polemics have been due to the "parsons, poets, artists, lawyers," metaphysicians, and the like, who, *as such*, and without the biological discipline needful for understanding the evidences of the question, have come forward to dogmatise on the formation and the correlations of species and have even laid the flattering unction to their souls that they, forsooth, were better able to appreciate facts than the men whose special task is observation and discovery.

These Babel-voices, literary, æsthetic, teleological, are now fading into a wholesome quiet, and Evolution is about to undergo its veritable trial—the scrutiny whether it can be fairly made to harmonise with and to account for the many puzzling phenomena which we recognise on every hand—whether the hypotheses which have been set up can be verified by exact research. If unable to stand this test they will be laid aside by naturalists without any bidding from the lay public.

The two works just mentioned, proceeding from authorities whose competence is beyond question, are valuable contributions to this great task, and though approaching the subject independently and from different sides, they are substantially in accord with each other. Prof. Semper—after a thoughtful and suggestive introductory section, of which anon—considers in detail the influence upon animal life of the environment in which it is placed, *i.e.*, nutriment, light, temperature, standing water, still air, flowing water, and living organisms. All these agencies may act upon animal species by transformation, by selection, and by dispersion, and their effects have as yet been but very slightly and imperfectly studied. Lamarck, indeed, as is well known, ascribed the development of plants and animals as we now find them to such causes as abundance, scarcity, or peculiar quality of food, excess or deficiency of moisture, and the like. But his views, however important, remained mere speculations, not verified by observation and experiment,—an undertaking which in his day would certainly have been found impracticable. "The task of the zoologist, therefore," says Prof. Semper, "is to examine how vital conditions act upon individual animals and their organs, in order to infer back to the physiological causes of the origin of different animal forms." It will be noted that he does not overlook the transforming or modifying agency of outward circumstances. Most naturalists now fully admit that "natural selection," or, indeed, selection of any kind, though it may preserve and increase advantageous modifications when once

they have taken their rise, cannot possibly explain their first appearance. Hence, before we can account for the origin of species we must know whether such conditions are in any case found to set up a tendency to variation, of which selection may take hold.

Mr. Wallace treats of the origin, and especially the dispersal, of species from a different point of view, basing his considerations on the faunas and floras of islands. He classes islands as oceanic—those formed by volcanic or coralline action in the midst of wide seas—and as continental, *i.e.*, such as have evidently at one or other point of time formed part and parcel of some adjacent continent. This latter group he sub-divides according as their separation from the mainland is of recent or of ancient date. The three classes thus formed present respectively most remarkable differences in their animal and vegetable population, and in pointing out these distinctions and explaining how such regions have first received their inmates, he is led to conclusions which may be usefully compared with those of Prof. Semper. Both authors examine the influence of temperature and recognise the changes of climate which have undoubtedly occurred upon our earth as important factors in the origin of species. Mr. Wallace shows, however, that "we find no indication that the almost perfect similarity of climate and general conditions has any tendency to produce similarity in the animal world." Prof. Semper, who has conducted very important experiments on certain species of mollusks exposed to abnormal temperatures, comes to the kindred conclusion that the fossil fauna of any region affords no trustworthy evidence as to its climate at any particular past epoch. He brings forward the remarkable fact that parrots, distinctly tropical birds, accustomed to an average temperature of 80° Fahr., have been found capable of living and increasing in the open air in England with a mean temperature not exceeding 50° Fahr.

Such considerations ought to inspire geological speculators with a wholesome caution.

Mr. Wallace enters at length into the action of oceanic currents and of storms in the distribution of species, and by their means he explains, as it seems to me very happily, the peculiarities of the faunas of the Azores, the Bermudas, the Gallapagos, and other remote island groups.

Professor Semper, too, examines very fully the agency of currents both as promoting and as limiting the distribution of animals, and as sometimes checking the formation of new species. As regards the action of the wind in regulating

the fauna of the West African islands above referred to, he agrees substantially with Wallace.

With reference to the zoo-geographical classification adopted by our illustrious countryman, he remarks, however, that it is scarcely possible to conceive a greater contrast than that existing between the fauna of Hong Kong, Amoy, or even Siam on the one hand, and that of Borneo, Java, and Sumatra on the other,* a distinction which is repeated in a very striking manner in the Phillippines, whose northern portion shows an unmistakable approach to the true Chinese type, whilst the southern islands point very decidedly towards Borneo on the one hand, and towards Celebes and Gilolo on the other. These features may be traced in the mammals, fish, reptiles, insects, and very clearly in the mollusks. What may be called the endemic fauna of the islands occurs in its nearest approach to purity in the centre of the group. These characteristics he explains by oceanic currents and by the changes of the monsoons. He does not, however, suppose that affinities between locally remote faunas can be universally thus explained.

We meet, further, with a criticism of Wagner's "Theory of Migration," which Prof. Semper considers as not really in opposition to Darwinism, as its author supposes, but as therein included. It may be said, then, when Mr. Wallace declares that species can arise only where there is room for them, he gives all that is really valuable in this supposed new theory.

Prof. Semper deals thoroughly with the vexed question of hybridism, refuting *seriatim* the four positions of the old school, viz., that hybrids do not exist at all, save in a few exceptional cases; that, if produced, they are always, or nearly always, unfruitful; that hybridisation never occurs without human intervention; and that species which have been known to produce fertile hybrids are mere varieties, morphologically but not physiologically distinct. All these popular delusions are completely shattered to pieces by the facts here adduced, observed among mammals, birds, reptiles, fishes, insects, and even mollusks. One of the most interesting cases is that of *Tetrao medius*, now known to be a hybrid between the great *Tetrao urogallus* (cock of the woods, or capercailzie) and the black-game, *Tetrao tetrix*, and which in many districts is fast superseding the latter. But the most important lesson hence to be learnt is that in hybrids there

* It must here be remembered that Mr. Wallace places the former realms in the Indo-Chinese, and three latter in the Indo-Malayan sub-division of his Oriental region.

appears not merely an intermixture in varied proportions of the parental attributes, but the latter are rendered unstable or mobile, and the young become more easily modified by the conditions in which they are placed. A splendid field for experimental research is here opened.

Mr. Wallace does not discuss hybridism and its consequences. But he holds that species are not all and at all times equally variable, and he shows reasons for assuming that the present condition of the earth is one of exceptional stability as to climate, and consequently of exceptional stability of species. It need scarcely be said that these considerations supply the solution of certain serious difficulties. They meet the objection of the almost infinite lapse of time required for the evolution of species, if its rate is supposed to be constant: they answer—if any answer is needed—the cavil that none of us have witnessed the evolution of a new species, and they will surely satisfy those "eingefleischte anti-Darwinianer" who still cling to the "Egyptian" fallacy.* It is remarkable that the the climatic conditions of Egypt have probably undergone less modification during the past three thousand years than those of most other countries. If, then, its present animals are exactly similar to those found as mummies or depicted on its monuments, the fact is in accordance with, and not in opposition to, the doctrine of Evolution.

Prof. Semper gives a much-needed caution against the too common error of arguing from the position of an animal in the zoological series and from the structure of its organs, *e.g.*, its dentition, to its habits and its selection of food. The well-known pond-snail, *Lymnæus stagnalis*, belongs not merely to a herbivorous group of snails, but its teeth are formed on the true plant-eating type. Yet it attacks and devours the small water-newt, *Triton tæniatus*, even in an aquarium full of flourishing water-plants. The present writer has seen the same species feasting on frog spawn, though there was at hand vegetable food in abundance. Some of the rodents are purely vegetarian; others, with similar dentition, are semi-carnivorous, like the rat or the squirrel, which the author very correctly pronounces "the greatest enemy of our song birds, whose eggs and young it devours in great numbers."†

He holds that "by far the greater number of animals

* Journal of Science, 1880, p. 166.

† As this marauder has also a decided taste for wall-fruit he ought to be extirpated wherever practicable.

depend upon light only through the mediation of the eyes." With all due deference I must beg to point out that according to the researches of Moleschott and Fubini (*Mitheilungen aus dem Embryologischen Institut zu Wien*, iv., p. 265) "the action of light in promoting the metamorphosis of matter is exerted not merely through the eyes but through the skin, and can be traced even in blind frogs, birds, and mammals. If the eye alone or the skin alone is stimulated by light, the increased escape of carbonic acid is smaller than when the entire body is exposed to light.

With reference to the brilliant colouration of the sea-anemones and the true coral-polypes often compared to submarine flowers, Prof. Semper shows that this beauty is not to be explained on the principle of sexual selection. Both males and females being rooted fast cannot seek each other, but emit their sexual secretions into the water, leaving it to the currents to effect the fertilisation of the ova. As little can the decoration of these polypes be classed among the "protective" or the "warning" colours. They are not concealed but rendered more conspicuous, both to their possible prey and to their enemies, and the latter, such as the *Scaridæ* and the *Diodontidæ*, are not in the least deterred by the sight. We must, therefore, refer these colours to the "typical" class described by Mr. Wallace.*

Prof. Semper is, however, inclined to hope that both the production of pigments and their distribution in different parts of the animal system may be soon rendered intelligible. He admits the existence of mimicry, as established by Bates and Wallace, and detects instances of it even among snails. But he adds the caution that any agency which may, indeed, select, but is unable to transform, cannot be regarded as the efficient cause of any phenomenon. This warning, which the author reiterates, marks his distinction from that of not a few naturalists who have dealt with the question of Evolution. But the same lesson is to be found, though perhaps less explicitly, in the work of Mr. Wallace. He, too, urges that geographical and geological changes, "the alternations of warm and cold, or of uniform and excessive climates—of almost perpetual spring in arctic as well as in temperate lands, with occasional phases of cold culminating at remote intervals in glacial epochs," have played not a mere selecting but a modifying part, and have thus produced "some of the more remarkable changes in the specific character of organisms." Hence it is plain that the co-discoverer of "natural selection" guards

* Macmillan's Magazine, Sept., 1877, p. 392.

us against the popular error of ascribing to such selection the origin of the variations upon which it has afterwards to act. In one case Mr. Wallace advances statements which have the semblance at least of discrepancy. On p. 73 he remarks that "reptiles appear at first sight to be as much dependent on land for their dispersal as mammalia, but they possess two peculiarities which favour their occasional transmission across the sea—the one being their greater tenacity of life, and the other their oviparous mode of reproduction." Yet on p. 319 we read:—"To this cause we must impute our comparative poverty in mammalia and reptiles—more marked in the latter than the former, owing to their lower vitality and smaller powers of dispersal."

Mr. Wallace's sections on the permanence of the distribution of land and water and on the causes of glaciation must be passed over, as I find that they will be considered separately in some future number of the "Journal of Science."

Prof. Semper's introductory chapter is fraught with useful lessons which are sometimes left out of view even by the more advanced student. The author considers the distinctions between adaptive and hereditary peculiarities. He shows that parts, which from their adaptive character have little or no meaning in determining the affinities of the higher systematic groups, acquire a very great diagnostic value for smaller divisions, within which they must rank as hereditary. Hence it is impossible to draw an *à priori* distinction between adaptive and hereditary characters. He shows the necessity for the naturalist, of a "physiology of organisms" superadded to the physiology of organs which has been vitiated by being ordinarily treated and, studied exclusively with reference to medical practice. This is a deplorable fact. It may be inquired what would be the state of chemistry if cultivated merely from a pharmaceutical point of view, or of astronomy if confined to the service of navigation? If it be asked what is such a "physiology of organisms," the author replies that it comprehends all those laws which are perceived on investigating the vital relations of different animal species to each other, and to the conditions by which they are, as such, preserved, destroyed, or transmuted. As an instance of the problems with which this branch of science has to deal he mentions the discovery of the causes which have led, in vertebrate animals, to the development of the two pairs of limbs and two only.

There is very much more in this work well deserving of special notice, such as the account of the eyes—of the true vertebrate type—found in the back of the molluskous genus

Oncidium, and the author's speculations on their origin. But space forbids any further remark or exposition, save of Prof. Semper's hypothesis of coral formations, which cannot be passed over in silence.

Few men of general reading are in these days ignorant of the theory now generally received on this subject. It was first propounded by Mr. Darwin in his "Naturalist's Voyage," and explained more in detail in his subsequent treatise on the "Structure and Distribution of Coral Reefs," and was independently discovered by Prof. Dana.* Its leading points may be shortly recapitulated as follows:—There are three great classes of coral reefs, atolls, barriers, and fringing reefs. The first kind are ring-like reefs enclosing a lagoon or tract of water; the second class "either extend in straight lines in front of the shores of a continent or of a large island, or they encircle smaller islands; in both cases being separated from the land by a broad and rather deep channel of water, like the lagoon within an atoll." The fringing reefs where the land slopes abruptly under water are only a few yards in width, but where the slope is gentle there may be a channel—usually narrow and shallow—between the coral formation and the land.† Mr. Darwin's theory is that the atolls and the barrier reefs are founded on and intimate areas of subsidence, the coral polypes building in shallow water and working upwards as the foundation subsides. Fringing reefs, on the contrary, show that the shore must either have remained stationary or have been elevated.

Professor Semper, during a somewhat prolonged residence in the Pelew Islands, has been led to decidedly different conclusions. In these islands he has found shallows without any reefs closely bordering on atolls. The west coast of this group is steep, whilst the eastern shores slope very gradually down. According to the Darwinian theory there should hence be a fringing reef on the western side and a barrier on the eastern. The reverse is the actual case. On the eastern side there is a fringing reef, whilst on the western is found a barrier reef four or five miles from the land, and interrupted by three channels which do not lie opposite the mouths of rivers, or even of streamlets. He considers that the occurrence of large detached blocks of coral at the outer margin of all the reefs on the western side, the large, almost horizontal submarine plain to the north of Peleliu, the uninterrupted con-

* See Journal of Science, 1875, p. 534.

† Journal of Researches into the Natural History and Geology of the Countries visited during the Voyage of H.M.S. *Beagle*. By C. DARWIN. P. 472.

nection of the eastern reefs of Pelelin and Kreiangel with the dead elevated coral cliffs all argue against any recent subsidence. The author's own theory is that the growth of corals is chiefly influenced by the strength and direction of the oceanic currents. Wherever constant and deep currents strike a coast tangentially the reefs are compelled to grow vertically upwards, and on the other hand many corals have the tendency to spread out equally on all sides, as far as possible, when shallow currents sweep over them. He considers that the peculiarities of the Pelew reefs can all be explained by the action of such currents during a period of elevation.

He observes that certain corals, such as the Astreæ and Porites, form circular masses of a regularly convex surface. The polypes on the summit are as well developed as those on the sides, so long as they are never laid dry at time of ebb. Larger blocks of the same kinds become flat on the summit, which is exposed even at ordinary ebbs, the polypes being dead and covered with sand and sea-weed. In still larger masses the surface is concave with an elevated margin, presenting, in fact, the likeness of an atoll in miniature.

It is obvious that if Professor Semper's theory holds good, much of our present conclusions concerning supposed areas of subsidence will require to be carefully reconsidered. On Mr. Darwin's hypothesis an atoll in the present day is the monument over, or rather around, the grave of a submerged island. At an earlier date it must have been a barrier reef surrounding a small, generally mountainous, plot of land. Would it not be important to search whether at or near the centre of a lagoon within such atolls there could be found traces of rocks other than coral or its transformations? It will also be essential to examine the relations of the more characteristic atolls, barrier reefs, and fringes, to prevailing currents.

Regretting the necessary shortness of this survey of the teachings of two most significant works, I must recommend them to the careful study of the reader.

ANALYSIS OF BOOKS.

Our Summer Migrants. An Account of the Migratory Birds which pass the Summer in the British Islands. By J. E. HARTING, F.L.S., F.Z.S. London: Bickers and Son.

WE have here an account of forty-nine species of birds which regularly or occasionally visit this country in the summer season, and, after laying their eggs and rearing their young brood, depart to spend the winter in some milder climate. We say generally because the author includes in his survey two beautiful and harmless species, the hoopoe and the golden oriole, which are only occasionally to be seen in our woods and gardens, and are, for the most part, wantonly murdered as soon as they are recognised. The brutish idiot who has done the deed then writes to the papers, and conceives that he has rendered a service to Natural History. One wretch, as here recorded, finding an oriole's nest, near Sandwich, took the young birds and gave them to his ferrets. Thus the true naturalist is deprived of the opportunity of studying the habits of such species. It is remarked that the hoopoe and the oriole were formerly more numerous in Britain than at present, and unless the law is sharpened and public opinion becomes more enlightened both these birds will soon rank in the extinct list, as far as these islands are concerned.

The stork, which was once as regular a summer visitant in Britain as on the opposite shores of Holland and Belgium, has already disappeared from our list, and is not noticed by Mr. Harting.

Even the nightingale is in no little peril. We learn that in 1867 "three London bird-catchers between April 13th and May 2nd took 225 nightingales," and that the previous year "these same bird-catchers had supplied the dealer by whom they were employed with 280 nightingales." It is manifest that no species—save, perhaps, the sparrow—could resist such an addition to the natural causes of destruction against which it has to contend. The possessing or offering for sale a captive nightingale ought to be visited with a heavy penalty. Let once the bird-catcher and the dealer be fined in sums heavier than they can possibly realise by the sale of the unfortunate captives, and they will very soon drop their unhallowed business. As far as we remember, the penalty in Prussia for capturing nightingales during the breeding season is about £4 10s.

Mr. Harting's accounts of the various species deal principally

with their habits, localities, times of arrival and of departure. Structural descriptions are not given, and are the less needed as the illustrations are from Bewick's designs, and need consequently no encomium.

The protracted discussion whether the young cuckoo does actually eject its foster-brothers or sisters from the nest is here decided in the affirmative. That the parent birds fail to distinguish their true offspring from this interloper, or recognising him do not interfere, is one of those strange instances of animal stupidity which it is hitherto impossible to account for. Perhaps, however, higher beings—if modern "advanced thought" will allow that any such exist in the universe—may be equally puzzled with the occasional stupidity of man. It is suggested that the nerves and muscles of the young cuckoo must be much more developed than its outward appearance would warrant. Yet along with the direct evidence that the cuckoo lays her eggs in the nests of other species (which has never been disputed), and that the young eject the rightful tenants, it is mentioned that—"In Fife, Forfar, and Tayside Mr. P. Henderson, from personal observation, has frequently found cuckoos' breasts bare of feathers, as if from incubation, and has observed the old birds feeding their own young." It would be interesting to inquire whether in none of the fifty-seven species of birds intruded upon the young have developed a means of defence against the operations of the nestling cuckoo?

Mr. Harting's work ought to be in the hands of every student of British Ornithology, and will prove an incitement to observation.

Betrachtungen uber die Entwickelungs-Geschichte der Schmetterlinge und deren Variation. By A. KEFERSTEIN. Erfurt: Carl Villaret.

WE find here, in the unpretending form of a pamphlet of 116 pages, a collection of facts connected with the development and variation of Lepidopterous insects. Much of the information here given is rare and curious, not to be met with in ordinary entomological treatises, and has been selected by the author from the transactions of learned societies with great care and diligence. He surveys these insects in their four successive phases of egg, larva, pupa, and imago. Under the first of these heads he mentions the fact that cases of viviparous reproduction, though decidedly exceptional, are not unknown among moths (*Tinea*, *Oeketicus*). He mentions that the eggs of different species of the same genus do not appear to be similar in form,—those, *e.g.*, of *Vanessa Polychloros* being smooth and bottle-

shaped, whilst the eggs of *V. Io* and *V. Atalanta* are ribbed and cylindrical,—a phenomenon which deserves more extended investigation.

He considers that the difference of sex is to be traced even in the egg, and is not, as some naturalists assume, influenced by the larger or smaller supply of nourishment during the larval condition. In connection with this subject he enters upon the question of parthenogenesis,—a phenomenon far from rare among certain Micro-Lepidopterous genera; *e.g.*, *Fumea* and *Solenobia*. He finds it thoroughly established that the females of species belonging to these groups, without impregnation, deposit eggs from which larvæ are produced. Such caterpillars yield, however, female moths only, which continue to reproduce themselves in the same manner. Whether this kind of propagation is limited to a certain number of generations or may go on indefinitely does not appear.

Turning to the larvæ of moths and butterflies, Herr Keferstein devotes much attention to the irritant and poisonous secretions of many species. In certain species the hairs appear to be hollow, forming veritable stings, and are connected with true poison-glands at their base. Naked caterpillars are also poisonous. Prof. Zeller suffered severely from touching the larvæ of *Depressaria venificella*, which he found feeding upon *Thapsia gargarica*, in the neighbourhood of Syracuse.

On the diet of Lepidopterous larvæ we find a great number of observations, far more species being carnivorous than it is commonly supposed.

It is remarkable that whilst the caterpillars of some butterflies can be reared up to maturity in utter darkness, those of *Parnassius Apollo*, according to Prof. Von Siebold, refuse to feed in the dark.

It is well known that the adult death's-head moth (*Acherontia Atropos*) utters a squeaking sound if touched, but, according to Brauer, its larva stridulates also.

That the caterpillas of certain species should in their earlier stages appear respectively undistinguishable, and should afterwards assume characteristic differences, is what we should expect according to the principle of Evolution. But the larvæ of *Danais Phidippus* and *Bombyx Vishnu*, two species remote from each other in any possible classification, can only be distinguished by their respective size and by the plants they feed upon. On the other hand, there are cases (*Acronycta Psi* and *tridens*) where the perfect insects are scarcely to be distinguished, whilst their respective larvæ are plainly different—a most perplexing fact, of which several instances are known.

As regards the pupa-state there are, as might be expected, fewer interesting phenomena to put on record. Pupæ are, however, by no means so helpless, motionless, and unconscious as they are often represented, and the notion—common among the

lay public—that the pupa condition is a kind of death which should entirely dissociate the past and the future career of the insect, is ill-founded.

We come now to the imago condition. Here the author, with somewhat questionable prudence, attempts the definition of the illusive idea "species." He says:—"Hereby the notion of species is established that we say of butterflies which copulate with each other, lay eggs, and so produce descendants of the same character, which again give birth to similar beings, that they make up a 'species,' or 'belong to one species.'" He quotes also Piochard de la Brulerie, who defines species as the "totality of beings who are capable of producing to infinity beings identical to themselves." As we have not observed an infinite number of generations, either of butterflies or of any other animal, we cannot accept these definitions which assert the permanence of species, and overlook the cases of hybridism which are known to occur in Nature, and are probably far from rare. Herr Keferstein examines the various morphological characters by which species are distinguished,—such as size, antennæ, palpi, feet, wings, scales, pattern, &c.,—and finds them all liable to fluctuate.

Entering upon the different classes of varieties and their causes, he enumerates sexual variation, the distinction (where it exists) between the male and female of the same species; generation-varieties—cases where, *e.g.*, the summer and winter or the spring and autumn brood differ; climatic and local varieties, of which the author enumerates many interesting instances; ordinary varieties, those which cannot be explained,—*e.g.*, the twenty-four varieties of *T. parmatana* which Fischer von Röslerstamm obtained from a single brood of larvæ. Hybrids and monsters he classes as aberrations. He enumerates a number of variations produced by unusual diet, though his own experiments in this direction have given merely negative results. He considers that the beginning of variation must be sought for in the egg.

In conclusion we find a few remarks on the odours, the luminosity, and the stridulation of different Lepidoptera.

We can commend this little work to entomologists as a treasury of interesting facts, and we feel certain that all will regret to learn that the author's researches are suspended by the severest affliction which can happen to an observer of Nature—a serious affection of the eyes.

A Reply to Criticisms on "The Problems of Insanity," with Remarks on the Gosling Case. Delivered before the New York Medico-Legal Society, April 16th, 1880. By G. M. BEARD, A.M., M.D.

IT appears that on March 3rd Dr. Beard read a paper before the above-named Society, on "The Problem of Insanity." At the April meeting of the Society Dr. Hammond read a paper on the "General Paralysis of the Insane," and the final discussion of Dr. Beard's paper was postponed to a special meeting, April 16th. In his concluding speech Dr. Beard defends his definition of insanity as a "disease of the brain in which mental co-ordination is seriously impaired." He maintains that a definition of insanity is very necessary, and that his definition or short description—though it does not penetrate to the essence of the condition, is a practical working definition, which may be fairly used either in the scientific study of the question or in a court of justice.

In some appended remarks on a celebrated case which had recently engaged the New York courts, the author makes the following just observation:—"In studying fever we visit the patient a number of times before we make out a diagnosis, but in studying insanity the assumption is that a single visit is sufficient, even when we know nothing about the previous carriage of the patient, and therefore have no means of contrasting his present with his past and habitual behaviour, which is the most determining element in establishing the diagnosis of insanity."

Among the many "happy thoughts"—rising almost to the value of aphorisms—with which this reply abounds, space allows us to select one only:—"We may be justified in condemning a man scientifically when we have no right to condemn him legally."

Charles Waterton. By JAMES SIMSON. Edinburgh: Maclachlan and Stewart.

THIS treatise, which can scarcely be termed an *éloge*, has been called forth by the re-publication of Waterton's "Essays" and "Wanderings," edited respectively by Mr. Norman Moore and the Rev. J. G. Wood, and contains not a few extracts from a previous work of Mr. Simson's which we regret has hitherto escaped our notice.

With the author's estimate of Waterton as a naturalist we find a difficulty in dealing, since in a number of important points it agrees very closely with our own, as expressed in the articles

"The Balance of Nature" and "Gilbert White Reconsidered."* In these essays we have referred to Waterton's deficiencies as a systematist, to the paucity of the work he actually produced if taken in comparison with his splendid opportunities, to his inconsistency in denouncing scientific terminology whilst indulging in needless classical quotations, to his errors on the skunk, on serpents, on wild dogs and wolves, on the Quadrumana, &c. We have noted his disposition to deny altogether any fact which had never come under his own observation, and we have pronounced him "an odd mixture of obstinate credulity and of scepticism equally stubborn." It is therefore with no small interest that we find our opinion confirmed by Mr. Simson, who has quite independently arrived at conclusions very similar. Nor have we overlooked that eccentricity which pervaded Waterton's whole character, and which is the only conceivable excuse for his suppression of the bulk of his own observations. What, for instance, has he put on record concerning the five thousand specimens which he dissected? We have expressed our regret that Waterton should have obtruded his peculiar religious and political opinions upon our notice in works treating ostensibly on Natural History. Nor have we overlooked his irritability and pugnacity. Still it must be remembered that he was placed under great temptations. He had to deal with rampant charlatans and their worshippers, and with one who, though no quack, was the champion of that incomprehensible delusion the Quinarian system.

The utterance of Mr. Moore that "there is nothing on tropical natural history which deserves to be named with the 'Wanderings'" seems to us strange indeed, remembering that it was written in 1871,—a date subsequent to the appearance of Mr. A. R. Wallace's "Malay Archipelago."

We can scarcely agree with Mr. Simson in supposing that Waterton's aristocratic standing went any way in securing his position as a naturalist. Whatever influence he might have possessed as the head of an ancient county family would be more than lost by his religious and political peculiarities. Sympathy with the enemies of England, at home or abroad, was not in his day a passport to favour and power.

A very large proportion of the present work is devoted to the consideration of Waterton not as a naturalist, but as a man,—a matter in which we feel but little interest. Whether the Squire of Walton Hall managed the family estates in Demerara well or ill, in what manner he ought to have prepared himself for the post, and whether his conduct under Custom-House persecution was judicious or otherwise, are points of small moment. Waterton himself would have found difficulty in saying anything too strong of a Government which displayed the unwise meanness

* Journal of Science, 1877, p. 145, and 1880, p. 632.

of imposing a tax upon zoological or geological specimens. Twenty per cent *ad valorem* was a most oppressive exaction upon articles which have no regular commercial value, and which might be estimated at any arbitrary figure by officials, unless duly bribed. The first step towards abolishing such laws is to exhibit them and the persons engaged in executing them in the most hateful and contemptible light. We have heard, on good authority, that prior to the abrogation of these imposts many collections, that would otherwise have been brought to England, found their way to other countries, whilst numbers of travellers were deterred from accumulating specimens on account of the penalty which would await them on their return home.

Much as we differ from Mr. Simson on this point we shall be very happy to meet with him again as an author. It strikes us that he is one whose thoughts are well worthy of attention.

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*Die Mythologie der Griechen und Roemer, unter steter Hinweisung auf die Kunstlerische Darstellung der Gottheiten: as Leitfaden fur den Schul und Selbst unterricht bearbeitet.** By Dr. Otto Seemann. Leipzig: E. A. Seemann.

This book, we are told, is an abstract of a larger work by the same author, which appeared five years ago, under the title "Gods and Heroes of the Greeks." Dr. Seemann's point of view, as will be seen from the title, is in a predominant degree æsthetic. He treats the now deposed divinities of antiquity as subjects for the artist.

Considerations on the origin and meaning of the myths are meantime not wanting. An introductory distinction is drawn between myths—in the stricter sense of the term—and sagas, the former being restricted to tales of the gods and their doings, whilst the latter is applied to the stories of the demi-gods or heroes. Both are distinguished from fables as being not mere consciously fictitious products of the human imagination.

The majority of the myths, Dr. Seeman considers, took their rise in the contemplation of natural phenomena which primitive man is apt to refer to the intervention of divine beings. Gradually these personified forces of Nature were more and more invested with a human form and a corporeal character, and were viewed as a family or clan, presided over by Zeus, "father of gods and men." The gods of old Italian tradition underwent this personifying process less completely than those of Greece,

* The Mythology of the Greeks and Romans, treated with constant reference to the Artistic Representation of the Deities: a Guide for School and Private Study.

and the subsequent identification of the two mythologies was chiefly confined to the poets and the learned, and never probably penetrated to the lower classes of Rome.

The author then describes the cosmogony and theogony of the Greeks, a section of mythology which was never thoroughly naturalised in Italy. With reference to the conflicts of the Gods and the Titans and Giants, said to have raged in the fields of Thessaly, Dr. Seemann remarks that this district plainly bears the marks of former natural convulsions. He thus suggests that these myths may have had a foundation in fact. But it is no part of his more immediate purpose to explore these border-lands of geology and mythology.

We cannot here follow the author through his full, able, and clear account of the various deities of Greece and Rome—"gods on half-pay," as they were somewhat wickedly called by Heine. The attributes of each and the chief sites of his worship are clearly described. The illustrations, taken from the most celebrated statues and reliefs, are both numerous and admirable, and the work is thus especially adapted for students of the fine arts.

The author, or the publisher, makes use of the new German orthography, which, like American English, is an uncomfortable compromise between the phonetic and the traditional ways of spelling.

A Synopsis of Elementary Results in Pure and Applied Mathematics, containing Propositions, Formulæ, and Methods of Analysis, with abridged Demonstrations. By G. S. Carr, B.A. Vol. I. London: C. F. Hodgson and Son.

This work opens with a series of mathematical tables. We have the Centimetre-Gramme-Second system of units, including the values of the dyne, the erg, ohm, volt, weber, the electrostatic and electro-magnetic units, &c. Next follow physical constants and formulæ, including a table of values for the principal lines of the spectrum in air at 160° C. and 76 c.m. barometer. After this section come Burckhardt's factor tables for all numbers from 1 to 99,000. The remainder of the work is devoted to algebra, the theory of equations, plane trigonometry, spherical trigonometry, elementary geometry, and geometrical conics.

The author's object is to supply a compact summary of the fundamental theorems, formulæ, and processes in the chief branches of mathematics. His compilation will prove very useful to advanced students.

Nature's Bye-paths. A Series of Recreative Papers in Natural History. By J. E. TAYLOR, Ph.D., F.L.S., &c. London: David Bogue.

WE have here a collection of pleasant, chatty essays, whose connection with natural history in the ordinary sense of the term is not always of the closest. Thus the chapter entitled the "County Palatine" is devoted to a description of Lancashire life and manners rather too eulogistic, but otherwise so correct that we could almost suspect Dr. Taylor of being a native of the county he celebrates. There is a very fair account of the working class entomologists and botanists of the Northern counties, who, however, if we are not mistaken, are neither as numerous nor as eager in their researches as was the case forty years ago.

The "Story of a Recent Scare" is devoted to the redoubted Colorado beetle. The author does not apprehend that it will become naturalised itself in England. Indeed, it is remarkable how few American species, animal or vegetable, have succeeded in establishing themselves in Europe. The current of emigration seems to set in the opposite direction. To what extent our insectivorous birds would rid us of an invader which appears to be poisonous is of course open to doubt. We may be very sure that the sparrows will not attack him so long as there is corn or fruit in the neighbourhood.

"Old Wine in New Bottles" is a dissertation, not on plants or animals, but on popular traditions.

"Scientific Pilgrims," as the reader will doubtless expect, is devoted to the British Association, painted, perhaps, rather too strongly in rose-colour. The author seems to forget that if this Association has proved a model for other countries to copy, it was by no means the first body of its kind. As part of the excitement created by these great gatherings, mention might have been made of the sermons which are invariably preached *at* —or rather *against*—Science and her followers, sometimes by local divines, and sometimes by dignitaries who come down for the especial purpose. We are thankful to find here no reference to Prof. Tyndall's "Belfast Address."

A "Naturalist on the Tramp" opens pleasantly with an account of the geology and botany, and the glorious, though scantily visited, scenery on the west coast of Ireland. He takes us then to North Wales, and expatiates rather too much on the slate quarries—concerns very lucrative to their owners, but which are disfiguring the country in a way not pleasant to contemplate. Lastly the said naturalist finds—or loses—his way into the Black Country, where the flora has disappeared, the fauna has been reduced to colliers and bull-dogs, and where, save for the geologist, there is nothing left to observe.

Much more agreeable reading is to be found in the sections on the "Geological Dispersion of Animals and Plants," on the "Time of Catkins," the "Flowers of the Prime," "Violets

Blue," "Summer Meadows," and "Hedge Garlands." Dr. Taylor is by no means the "dry" man of science whom the outside world regard with such horror. He has a keen eye and a loving heart for whatever is beautiful in Nature, and his book will, therefore, prove a pleasant companion.

Elements of Astronomy. By R. S. BALL, LL.D., F.R.S., Royal Astronomer of Ireland. London: Longmans, Green, and Co.

THIS book, though mainly intended for beginners, is a scientific, not a popular treatise. The author not merely avoids the opportunities for somewhat sensational contemplation which his subject affords, but his physical descriptions of the nearer and better known heavenly bodies are kept well within the limits of what is actually demonstrable. Thus, in treating of Jupiter, he leaves to other works the consideration whether this huge planet is or is not, in addition to the light received from the sun, slightly self-luminous, nor does he discuss the question of the solid or molten character of its globe. For the physical theory of comets he also refers the reader to the well-known researches of Professor Zöllner.

T e work opens with an account of the principal astronomical instruments, the method of their use, and the phenomena to be observed. The evidence for the approximately spherical form of the earth and for its diurnal and annual motions are given with great clearness, and the various terms used by astronomers, such as right ascension and declination, polar distance, &c., are explained. Dr. Ball then considers the sun, its apparent motion, solar observations, apparent diameter, path in space, velocity, dimensions, sun-spots, &c. In successive chapters the motion of the earth round the sun, the moon, the planets, comets, and meteors, universal gravitation, stars and nebulæ, and the structure of the sun, are considered in turn. The remainder of the book is devoted to astronomical constants. A useful feature consists in the references to more extensive or to special works subjoined to many of the sections.

Dr. Ball avoids the error of many writers on astronomy who pre-suppose on the part of their readers very profound mathematical attainments. A knowledge of the elements of Euclid and Algebra, and a rudimentary acquaintance with the geometry of planes and spheres, is sufficient for a thorough understanding of this book. It has the high merits of clearness, simplicity, and soundness.

CORRESPONDENCE.

*** The Editor does not hold himself responsible for statements of facts or opinions expressed in Correspondence, or in Articles bearing the signature of their respective authors.

CHEMICAL NATURE OF GROUND IVY.

To the Editor of The Journal of Science.

SIR,—Can any of your readers inform me whether the chemical principle of the ground ivy (*Gleichoma hederacea*) has been isolated, and, if so, whether it is an alkaloid, essential oil, or otherwise? The medicinal effects of the plant (a specimen of which I enclose) are astringent and diuretic; it is also slightly tonic, and has been used as a lotion and internally with marked success in certain scorbutic affections, especially in cases of *Impetigo*; —I am, &c.,

E. R. H.

Newport, Isle of Wight.

THE SPIRIT OF NATURE.

To the Editor of the Journal of Science.

SIR,—When my attention was first directed to the article (in the September number of this Journal) bearing the above title I felt somewhat flattered to find my "Spirit of Nature" dividing with a honoured dignitary of the church the honours of so extended a notice. But on reading it I was not a little disappointed to find that while Mr. Slater had apparently done my book the honour of reading a great part of it, he had not done himself or his readers the justice of understanding it. While he might, by being at a little pains to unfold and clearly state the position I take up, have exemplified that courage and zeal for truth to which his class lay almost too vociferous claim, he prefers the method of the callow curate who dresses up a scarecrow "Darwin" or "Huxley" in order to pluck it mercilessly to pieces. He accordingly commences operations by drawing the following caricature:—

"Nature," he writes, on the second page of his paper, by way of elucidating our position, "is still declared perfect, and defended against the charge of 'cruelty;' pain and suffering, if

they cannot be fairly denied, are explained away; beauty is pronounced substantially universal, and is supposed to have been called into being for the special delectation of man; and last, but not least, the purposes of God are assumed as fully known and understood, according to the old use and wont of teleologists."

Now, as a matter of demonstrable fact, not one of these clauses describes my position with any tolerable degree of accuracy. Nowhere in my work is Nature "declared perfect" in the sense that Mr. Slater seems eager to attach to the assertion. I distinctly, and in so many words, disclaim the attempt to prove this the best of all possible worlds, which, if Nature were perfect in the full sense of the word, it would be. My book is rather an attempt to discover the tendencies of Natural Laws, to ascertain whether they point to justice or to injustice, mercy or cruelty, beauty or deformity. From a synthesis of such tendencies I seek to arrive at some conception of the Spirit of Nature. Nor do I "explain away pain and suffering" any further than by pointing out that we probably exaggerate the sensibility of the lower animals, and that there are certain indications of an effort on Nature's part toward alleviation of pain in cases where it can no longer act as an announcement of injury or stimulus to escape. Nowhere do I assert that "beauty is substantially universal," being fully aware of the difficulty of effectively upholding such an assertion as regards the animal kingdom, although I maintain, and I think establish, the prevalence of beauty in the plant-world; nor do I hold the tenable thesis that it is for man alone that such beauty was prepared. Beauty for its own sake seems rather to be Nature's aim. But the most wildly inapplicable of all is the last clause, in which we are accused of assuming the purposes of God as fully known and understood. As applied to my volume this statement has all the delicate fidelity which distinguishes the pencil-drawings of a child of four. And in saying this I do not forget that Mr. Slater has the Bishop of Carlisle's work also in hand, for what he there says ought to be true of both. Now the remainder of the article is so completely based upon the conception assumed here that its pertinence stands or falls with it.

As to the accusation of dogmatism (not to mention the humiliating and highly original charge of youth) it comes with scant grace from one who, throughout the article, shows himself nothing if not a dogmatist of the New Natural History. That the indictment is untrue I am convinced, not only from my own consciousness, but from the gratuitous statements of other critics as impartial if not so "superior" as Mr. Slater.

That he should confound my position with Paley's is possibly excusable, considering that he is probably one of the thousands who speak glibly of Paley's without any thorough acquaintance with his argument. None the less do I stoutly deny the identity

of my "pervasive intelligence" with the "watch-making Deity." Somewhat of the difference between us may be thus indicated—

An intelligent critic of my work writes:—

"The presence of intelligence as the counsel and regulation principle of the order of nature is the focus principle to which Mr. Baildon brings all his illustrations." Now this description would be very insufficient and incorrect as a summary of Paley's argument. Where I am content to show the action of intelligence, Paley's goes on into teleology, attempting to demonstrate definite intention and particular purpose. And herein lies the weakness of his argument. He tries too often to give a single definite answer to the child-like query "what is this for?" To such questions there is seldom or never a single simple answer, because the relations of any being to its surroundings are so complex and numerous.

I am anxious not to encroach on your space, and I think I have said sufficient to make it patent to your readers that the article in question gives anything but a true idea of my book.—I am, &c.,

H. Bellyse Baildon.

THE SPIRIT OF NATURE.

To the Editor of the Journal of Science.

Sir,—Never having previously come in contact with any of the *irritabile genus vatum*, I had little notion of their power of inventing grievances and of looking at facts, at opinions, and at persons, by "the light that never was on sea or shore." In the foregoing letter two charges are brought against me:—Misrepresentation or "caricature" of Mr. Baildon's opinions, and discourtesy. Turning to the former accusation, based upon a few lines at the top of 560 ("Journal of Science" for Sept.), it is, I maintain, incorrect. The passage in question, fairly construed in connection with the whole of the article, points out certain characteristics of a school of thinkers which are to be met with in certain degrees in the "Spirit of Nature." Mr. Baildon reminds us that he has disclaimed attempting to prove "the extreme theorem that this is the best of all possible worlds, or even that the process of struggle and suffering that we see is inevitable;" but he adds, sarcastically, "I must confess to so little acquaintance with any other world or process* that *I cannot contradict either theorem!*" Not merely so, but the whole book is filled with laudations of "nature" and censure of those who do not share his sweeping admiration. Referring to the opinion of John Stuart Mill that

* As if such acquaintance were necessary!

certain natural processes are unsatisfactory, he reproduces the sneering hope that this philosopher may have due warning "if plans for a new universe are required." I would, therefore, ask if a writer who goes so far is greatly wronged if he is said to uphold the perfection of Nature?" If I accuse B C of having stolen £100, has he any right to feel indignant if, on minute search, it appears that the sum pilfered was only £99 15s.?

He further writes:—"Nowhere do I assert that beauty is substantially universal." Yet on p. 59 he tells us that "natural objects are for the most part beautiful." Here again his own words fully bear out my construction. He denies having pronounced beauty as existing for man alone, but for its own sake—whatever that may mean. Yet on p. 59 we find him exclaiming against some who would have us believe that these things were in no wise made for beauty nor for the delight of man. The question implicitly put in my article ("Journal of Science," p. 570), for whom and for what ugly or loathsome things were made, he overlooks. If God has created beauty for his own delectation—which is, perhaps, the only rational interpretation to be put on the assertion that beauty exists "for its own sake"—"why," as Mr. Baildon asks (p. 61) "should the external aspect of an animal be so much more seemly than its internal? Are not both equally visible to God?

The attempt to deny or to explain away pain is so palpable in Mr. Baildon's seventh chapter that any attempt to prove it is utterly needless. I am aware that he professes a wish to "confine the inquiry to sub-human nature," but, as I pointed out in "A Change of Front," he loses sight of this limitation in the words:—"The impartial thoughtfulness of Nature puzzles us. We are offended to find the existence of a parasite cared for as tenderly as man." He says further, "unless *our* bodies were of invulnerable materials pain is indispensable," and he pronounces pain—if rightly or wrongly is not here the question—"an important factor in the evolution of *human* virtue."

He is particularly dissatisfied at the words, "the purposes of God are assumed as fully known and understood." Now in the "Spirit of Nature," p. 215, we read, "Nature is at once the Protagonist and Antagonist of man, at once his *Alma Mater*, his kindly mother, and the strong angel against whom he must for ever wrestle." Is not here the assumption of a knowledge of the Divine purposes, especially if we remember that one of the senses in which the word "Nature" is used (p. 95) is as a more reverent synonym for God.

The distinction between Mr. Baildon's "design and contrivance" and that of Paley is mainly that the latter goes more into detail. On p. 73 we find, however, a section which is thoroughly Paleyan.

Thus I submit that the representation which I have given of the author's views is essentially correct. Perhaps the offence

which I have committed really lies in the unpleasant facts I have brought forward.

Now for Mr. Baildon's charges of discourtesy and for the personalities with which his reply is so largely interwoven. Such charges surely "come with a scant grace" from one who decorates his book with such flowers of rhetoric as "intellectually and morally imbecile," "vulgar and stupid fallacy," "crude, thoughtless, criticism," "the Darwinian with his lack of metaphysical acumen," "atheistic flavour," &c., and who (p. 17) ascribes "ignorance and pride" to those who do not share his sentiments. Yet this writer feels highly aggrieved because I declared his work to be pervaded by a general tone of dogmatism and rashness. This indictment he considers "untrue," among other things from his own consciousness! Is he not aware that men are often serenely unconscious of their own peculiarities? Is it not, however, rash, even flippant, when a man who, whatever his powers and attainments, has not, I believe, distinguished himself by any important researches, magnanimously tells us that his "general aim is *not so much* to discredit Darwinism proper as to," &c.? Elsewhere we read of subjects "beyond the range of Tyndall's mental vision." Perhaps a happier term than dogmatism might have been selected to characterise the tone of such a book, but it was at any rate the mildest possible.

In Mr. Baildon's reply I am told that the article "A Change of Front" proves me to be nothing if not a dogmatist of the New Natural History." This is a singular assertion to make of a writer who implicitly declares himself not satisfied with the laws of selection and survival, and who (p. 567) admits that "the most advanced of us all have as yet but very shadowy conceptions" of the God-given laws of animal and vegetable development.

Again, mention is made of critics as impartial if not "so superior" as Mr. Slater. It would puzzle Mr. Baildon to show where I have laid claim to any superiority or obtruded my personality upon the reader at all. Again, it is declared that I do not understand the book, and it is next insinuated that I have wilfully misinterpreted it, being deficient in truthfulness—accusations hard to be reconciled. Mr. Baildon speaks of a zeal for truth to which my "class lay almost too vociferous claim." I have laid no vociferous claims to truth, nor does it matter what may be done by some "class" to which Mr. Baildon is pleased to refer me.

Various other little outbreaks of bad temper, such as the charge of not understanding Paley, I shall not notice. They certainly will not hurt me and they may perhaps relieve Mr. Baildon's excited feelings.

For one oversight I beg most sincerely to apologise. I considered and stated that amongst the evidences in favour of Darwinism Mr. Baildon had omitted all reference to embryology. I find that I was mistaken.—I am, &c.,

J. W. Slater.

NOTES.

THE meeting of the British Medical Association for the year 1881 will be held at Ryde, in the Isle of Wight, to which locality the Association has received a cordial invitation from nearly the whole of the medical profession in the island. Mr. Benjamin Barrow, an old and much-respected practitioner in Ryde, has been appointed President-Elect. The Council of the town of Ryde have passed a unanimous resolution that the whole of the Corporation Buildings, which are numerous and spacious, shall be placed at the disposal of the Reception Committee. There is every reason to believe that the many beautiful and private grounds in the Isle of Wight will be thrown open to the Association. The President will give a garden party to the members and residents of the island. A Soirée will be held in the Town Hall and adjoining buildings. The Address in Medicine will be given by Dr. John Syer Bristowe, London, of St. Thomas's Hospital; the Address in Surgery will be given by Mr. William Dalla Husband, of Bournemouth, Consulting Surgeon to the York County Hospital; and an Address in Obstetric Medicine by Dr. John Sinclair Coghill, of Ventnor. Such has been the spirit with which the movement has been taken up by the members of the Association and profession in the Isle of Wight and Ryde that the meeting bids fair to rival any previous meeting both in science and pleasure. The following grants in aid of scientific investigation for the year were made, viz.—Dr. McKendrick and Committee, Glasgow, for a continued investigation on anæsthetics, £25; Dr. Gerald Yeo, London, on the efficacy of the antiseptic method in injuries of the brain, £50; Dr. Thin, London, for a continued investigation on parasitic skin diseases, £25; Mr. W. North, London, for a continued investigation on the relations which exist between nitrogenous Egesta and muscular work, £50: Dr. D. J. Hamilton, Edinburgh, an investigation on the pathology of the brain, £30; Mr. Watson Cheyne, London, an investigation on the relation of organisms of septic diseases, £25; Dr. Augustus Waller, London, an investigation on the time and relation of muscular contractions in the human body in health and disease, £20; Dr. Alexander Ogston, Aberdeen, a continued investigation on the relation between Bacteria and surgical disease, £10; Dr. Newman, Glasgow, a renewed grant in aid of an investigation on the functions of the kidney, £10; Drs. Braidwood and Vacher, Birkenhead, to illustrate the third and final report on the life-history of contagium, £20.

MM. Couty and De Lacerda ("Comptes Rendus," xci., p. 549) have made a series of experiments on the absorption of the poison

of a Brazilian serpent (*Bothrops jaracara*), and of the local effects produced. If injected under the skin there ensue merely inflammations or abscesses, though the dose was five to six times greater than would have proved fatal if introduced into a vein.

M. J. Chatin has presented to the Academy of Sciences (Sept. 27, 1880) a paper on the ciliated embryo of the formidable parasite *Bilharzia hæmatobia*.

The charters of the Eclectic Medical College of Pennsylvania and of the American University of Philadelphia have been cancelled by the Supreme Court of Philadelphia, for selling spurious diplomas. Dr. Buchanan is now awaiting his trial.

The Council of the Royal Microscopical Society have under consideration the subject of increasing the utility of their extensive library, by lending books to the Fellows.

According to "Science," Prof. Richard Owen, formerly State Geologist of Indiana, proposes the following general law for the distribution of land on the globe:—"The land shows itself above the ocean level in definite multiple proportions, by measurement; the unit is the angular difference between the axis of revolution and the axis of progression."

In a paper on the physiological action of *Conium maculatum*, communicated by M. Rochefontaine to the Academy of Sciences, it is concluded that *Conium* may act like *Curare*, but it produces, besides, phenomena which have not been observed in animals submitted to the action of *Curare*.

According to a daily paper, which we need not name, an English officer on the Gold Coast encountered a spider which it required three shots with a revolver to despatch, its skin being too tough to be penetrated with a clasp-knife!

According to the "Veterinary Gazette" numerous specimens of an extinct species of horse have been discovered in France, approaching the recent horse more closely than any extinct species hitherto discovered, and forming a connecting-link between the genera *Equus* and *Hipparion*. The lateral metacarpals are distinct from the great metacarpal, whilst in the existing horse they are co-ossified for the greater part of their length.

At the late meeting of the American Association for the Advancement of Science, Prof. Morse called attention to the existence of a number of species of land shells in Yesso identical with forms met with in New England. Two species of slugs also are common to Japan and New England.

We learn, from the "Rocky Mountain Medical Review," that one A. Wilford Hall, in a work bearing the ambitious title "The

Problem of Human Life," aims at refuting the doctrine of Evolution, and, as a preliminary step, attempts to disprove the vibratory theory of sound!

A peculiar frog, found in the *tierras templadas* of Columbia, is said to yield a poison whose physiological action is similar to that of curare.

A most painful scene has occurred at a session of the Paris Academy of Medicine. During a hot discussion on the "cholera of fowls" M. Guérin addressed M. Pasteur in the following words:—"You are a liar, sir; I will send you my seconds." The "Medical Press and Circular" adds that M. Guérin is an octogenarian, and M. Pasteur hopelessly paralysed on the left side.

It is declared by Dr. Maclaren that the types of insanity have changed in modern times, and that acute delirious mania is becoming rarer. On the other hand, mental enfeeblement, often accompanied by paralysis, is more and more common, due to the overwork and worry of modern life.

The "Nineteenth Century" speaks of Dr. Carpenter as "the great English physicist."

We learn that the London Decorating Company, Limited, has arranged with Mr. W. Crookes, F.R.S., to supervise the chemical tests and processes employed to ensure the freedom of their paints, paper-hangings, &c., from poisonous and deleterious ingredients.

M. A. Gaudry has communicated to the Academy of Sciences an account of a new and highly-developed fossil reptile found in the Permian strata of Igornay, and to which he has given the name of *Stereorachis dominans*. It must have been a carnivorous animal of large size, as one of its jaws, though somewhat broken, measures 0·18 metre. It has affinities with the Ganocephal and the Labyrinthodons, as well as with the Theriodontes and the Pelycosaurians described by Cope. The discovery of so perfect a reptile in the Permian formation renders it highly probable that the remains of its forerunners may be found in the Devonian.

M. Savage has described, in the "Comptes Rendus," a fossil serpent from the *Ostrea Columba* beds of the Charentes. It has received the name of *Similiophis Rochebruni*.

According to "Les Mondes" a woman, named Judith Singer, died recently at Glowitz, in Silesia, at the age of 112 years.

We learn that J. G. Romanes, F.R.S., will deliver two lectures on "Animal Intelligence" before the Society of Arts.

Prof. Max Müller, at the opening meeting of the Mason Science College, at Birmingham, made the following excellent remark:—

"The professors of a College of Science should not be conservative only, satisfied to hand down the stock of knowledge as they have received it, 'laid up in a napkin.' Professors must try to add something, however little it may be, to the talent they have received."

The "specific poison doctrine" is considered altogether inapplicable to the history of enteric fever in India.—*Medical Press and Circular.*

In his Address at the inauguration of Sir Josiah Mason's College, at Birmingham, Prof. Huxley pointed out "how erroneous was the idea that a classical education alone could make a man of culture, and that the struggle which had for years been going on must end in placing the study of science and modern languages at least upon an equal footing with classics as a means to culture. He believed if a man could not get literary culture out of his Bible, his Shakespeare, and his Milton, he would not get it from the profoundest study of Homer, Sophocles, Virgil, and Horace.

The "Monthly Magazine of Pharmacy" considers "Spiritualism like the confidence trick, so palpably a sham that those who are so weak-minded as to be deceived by it deserve all they get or lose."

H. Buchner has succeeded in effecting the reciprocal conversion of the Bacteria of splenic fever into those generally found in infusions of hay. He has not yet succeeded in producing splenic fever with the unmodified hay Bacteria.

According to A. Renouard ("Biedermann's Central-Blatt für Agrikultur Chemie), water in which flax has been steeped not only kills fish, but is injurious to vegetation.

The following two modifications of Wickersheim's fluid for the preservation of animal substances have been proposed, *a* being for injection and *b* for immersion :—

	a.	*b.*
Arsenious acid ...	16 ounces	12 ounces
Common salt ...	80 ,,	60 ,,
Sulphate of potash	200 ,,	150 ,,
Nitrate of potash...	25 ,,	18 ,,
Carbonate of potash	20 ,,	15 ,,
Water	16 pints	16 pints
Glycerin...	6 pts. 8 fl. ozs.	6 pints 8 ozs.
Methylic alcohol ...	24 fl. ozs.	16 fl. ozs.

On October 28th the Literary and Philosophical Society of Halifax celebrated its fiftieth anniversary with—an operatic performance!

M. Delbœuf considers that there is no infallible and universal

sign which enables us to affirm with absolute certainty that a dream was a dream and nothing more.—*Revue Philosophique.*

The researches of Gustav Hausen ("Zeitschrift für Wissen Zoologie," vol. xxxiv., p. 367) seem finally to have decided the controversy concerning the function of the antennæ of insects. He has examined the behaviour of insects towards strongly odorous substances both before and after the removal of these organs, and when they had been coated with paraffin, and finds that after such operations they become indifferent to smells. Flies thus treated took no further notice of tainted meat. He shows also that the development of the antennæ in different insect groups decidedly harmonises with these experimental results.

According to the "Augsburg Gazette" the crayfish are perishing in numbers from an epidemic disease, the most striking feature of which is the development of white fungoid growths.

M. Etard ("Comptes Rendus") considers that boron ought to rank among the elements of the phosphorus series, not far from phosphorus itself, and at the head of the vanadium family.

M. Faye, in a paper read before the Academy of Sciences, contends that pellagra is produced by the use in food of grain which has not undergone the action of yeast or leaven.

M. Poirot ("Comptes Rendus") recommends wormwood as a remedy for the *Phylloxera*. It is said also to banish flies, ants, scorpions, and tarantulas.

In the earthquakes which ravaged Asia Minor in July last the fissures which opened in the soil are said to have emitted greenish black water and "sulphurous" fumes. It is much to be wished that these liquid and gaseous products could be submitted to a thorough analysis. Violent shocks were felt nearly at the same time in Manilla, the neighbourhood of Naples, and the Azores, where an island has risen out of the sea.

Mr. C. A. Feilberg, writing in the "Victorian Review," points out that the native vegetation of the inland parts of Queensland has a faculty of remaining dormant for months during the long and frequent droughts, and suddenly resuming active life on the fall of rain.

Mr. O. C. Marsh ("American Journal of Science," Ser. 3, vol. xx., p. 235), summing up the results of his researches on the mesozoic mammals of the Rocky Mountains, finds that they cannot be introduced into any existing order. With few exceptions the sixty species discovered are low, generalised forms, without decisive marsupial characters, and rather approaching the Insectivora.

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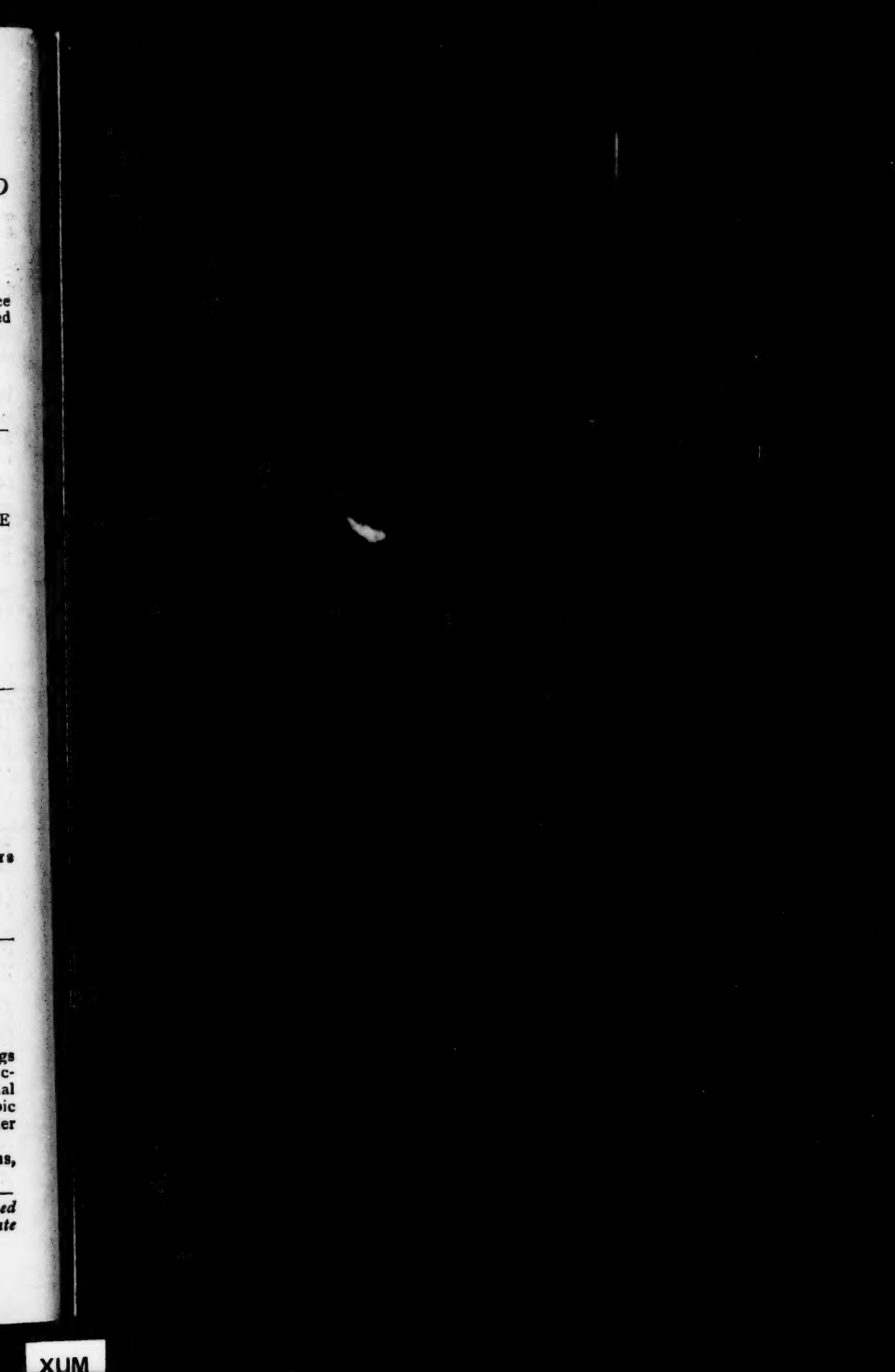
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